The Electrical World.

VOL. XXIX. NEW YORK, JUNE 12, 1897. No. 24.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New Yo k.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

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253 Broadway, New York.

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THE ELECTRIC LIGHT CONVENTION.

The twentieth convention of the National Electric Light Association, just closed at Niagara Falls, and a report of which appears in this issue, may well be regarded as, in many respects, the most important and interesting the association has ever held. The committee reports were of particular interest, and some of the papers presented were of an unusually high class.

The original purpose of the association was to gather together annually the members of the electric-lighting fraternity, so that by mutual discussion they might learn of each other's experience and so benefit the whole business. While this feature is perhaps still predominant, the conventions have grown to be also the occasions of annual gatherings of various persons interested in electricity from almost every standpoint, and have come to be in a sense a convention of the whole electrical trade as well as of the central-station men.

The lighter side of these conventions is always more or less prominent, and is certainly not the least feature of their attractiveness and value. At them men from various parts of the country meet and become acquainted. The meetings have served a useful purpose in bringing members of the electrical fraternity into closer personal relation with each other, and in this way have done much to unify and consolidate the electrical interests. Their influence has been directly for the good of the business in general, as well as of those who attend.

While the social features and minor gayeties which characterize all conventions were not forgotten in this instance, the gathering was generally commented upon as the most business-like meeting that has yet been held by the association. The discussions of some of the papers were more than ordinarily valuable in bringing out the views of men whose opinions are entitled to respect, while the papers themselves were of a class calculated to instruct as well as to edify those who heard them. It is a pleasant task to be thus able to sum up the twentieth convention as the best in the history of the association, and still more pleasant to be able to prophesy that from all indications the twenty-first convention will be still more valuable and attractive to those who may have the pleasure and privilege to attend it.

CHARGING FOR CURRENT.

In another column is an abstract of a paper presented at the National Electric Light Association's convention by Mr. Arthur Wright. The discussion of this most interesting and timely paper showed that there is a considerable desire on the part of central-station men to reform their system of charges on a more equitable and reasonable basis, and also indicated that the electric-light business in American cities has not been so conducted as to produce the maximum return upon the investment represented by the stations and lines.

There is absolutely no question that there should be inaugurated some system of charging more equitable than the flat rate now in general use and more reasonable than the discount system with which this is usually associated. If it be possible to accomplish at once, as has been stated, the two results most to be desired—the

increase of the total revenue of the station and the better satisfaction of the consumers of light—by any system of charging whatever, there is no question that that system should speedily be put in operation. Without going into details of the method which Mr. Wright suggests, there is no doubt that he has the germ of what will prove to be a more satisfactory basis of charge than any other yet attempted. It seems, however, that the idea of charges based upon the maximum demand might go further and include also any additional differentiation of the charges with reference to the times of day at which the maximum demand is made. All other conditions being equal, the maximum demand is a good basis upon which to formulate the rates for current, but there is unquestionably a greater expense incurred and a greater depreciation of the machinery of a plant when current is demanded at the time of maximum output than when it is called for during the periods of light load.

It is true that any customer connected with a central station is perfectly at liberty to make a demand for any amount of current up to the capacity of his installation at any hour of the day or night, but in practice his maximum demand comes at an hour which is generally fixed in reference to the maximum load hour of the station. It would seem, however, not difficult to add to the system of charges proposed another additional sliding scale of prices and discounts to be governed by the position of the customer's maximum demand with reference to the peak of the station load. In theory, at least, such a system as this is manifestly ideal, for the reason that it is the fairest both to customer and producer. Whether or not it can be reduced to such operative simplicity as would enable its general application is another question.

STANDARDIZING INCANDESCENT LAMPS.

The report of the Committee on Standard Candle-Power of Incandescent Lamps, of the National Electric Lght Association, includes some features of practical and sensible testing methods which will commend it to both the users and the makers of lamps.

It is a curious fact that photometric measurements are more difficult than any other in frequent use. The quantities of current energy, both mechanical and electrical, and of all the other elements that enter into the work of a central station, can be easily and accurately determined by comparatively simple instrumental means. The measurement of light—the absolute luminosity of any source of radiation—is, however, extremely difficult and complicated. This is especially true when it is required to compare the luminous qualities of sources of light of different colors.

The methods proposed by the committee for the testing of incandescent lamps betray a practical understanding of the nature of the problem, which is extremely satisfactory to those who will use the suggestions thus made in their daily work. The standards of light to be used in the regular comparisons of lamps are to be other lamps, of approximately equal candle-power. The method of comparison is so simple that it is reduced to an almost mechanical operation, well within the capacities of an unskilled operative. In effect, the whole of the careful and delicate operation of the initial comparisons with the standards of light are left in the hands of experts in such matters.

Rating lamps by their mean spherical candle-powers is perhaps more scientific than practical. In nearly all cases incandescent lamps are installed with the bulb downward, so that the mean hemispherical candle-power of the dome of the lamp would appear to be a more reasonable standard. The recommendation of actual measurement of the luminosity along a line inclined 45 degrees to the axis of the lamp seems to provide a very practical and reasonable way of arriving at the mean effectiveness of such lamps, and, after all, this is what is needed rather than a more scientific and comprehensive measurement.

THE ORGANIZATION OF INDEPENDENT TELEPHONE COMPANIES.

A convention of representatives of independent telephone interests is to be held at Detroit on June 22, the object of which is to perfect an organization for mutual protection and benefit. The necessity for such an organization is evident, and the good that can be accomplished by it is equally obvious.

The Detroit convention will probably be the first of a series of such meetings. While the circumstances which suggested the formation of a mutual organization by these companies are of a different kind from those which called the National Electric Light Association into existence, the future growth of the new association will doubtless be along the lines of the development of the older body. Mutual co-operation will amount to more in the case of telephone companies than in that of electric-lighting corporations in proportion to the more extended range of telephonic service. The establishment of trunk lines for long-distance or interurban telephony will be much facilitated by a cordial co-operation on the part of the various local exchanges.

The unification of the independent interests will give them a strength and standing they do not now possess. It will lead to the standardizing of telephone apparatus, introduce elements of competition into the business of telephony, stimulate invention, and generally benefit all engaged in this pursuit. Without entering upon the question of the legal status of independent telephony at present, it is at least safe to say that this will be in no way injured by such an organization as is proposed. Every independent telephone exchange and every manufacturer of telephone apparatus should make it a point to be represented at the Detroit convention.

THEFT OF CURRENT.

There has been in some cases an amusing and extraordinary legal difficulty in the way of convictions for theft of current. It has been gravely contended that, since electricity is not a thing or an entity which can be tangibly made evident, it is not criminal to steal it. It is hard to prove the theft of it, for even if the malefactor is caught red-handed, the electricity cannot be found upon him nor brought into court as part of the evidence against him.

Through the efforts of some of the central-station supply companies, action has been taken by the legislatures of several States defining the penalties for theft of current, and constituting such a theft an offense of which the courts may take proper cognizance. The legislative action, however, does not in most cases go far enough, because it does not make the punishment fit the crime, nor define the theft as a genuine larceny. Connecticut, which has recently passed such a law, puts current theft into the category of misdemeanors rather than into that of more serious offenses, where it belongs.

In former years, when the rudiments of electrical knowledge were less widely understood, and when electric-supply systems were more restricted than they are to-day, this theft was not a serious matter. Now, however, that the general distribution of elementary conceptions of electricity is so extensive, the knowledge of ways and means to cheat supply companies, whether by tapping their mains or shunting their meters, is in the hands of many persons who will bear watching. A strong and well-enforced law would be of substantial benefit in many cases, and should be contended for by all interested in the sale of current.

The Daylight Work of Central Stations.

A paper on this subject was read by title by Mr. T. C. Martin at the Niagara Falls Electric Light Convention. The paper was not discussed. Mr. Martin stated that the development of the central station industry has in some respects been a disaptrue, he said, that the companies restrict themselves injuriously by remaining mere lighting corporations. Electricity as an illuminant gains steadily in public estimation, and has at this moment no new rival within speaking distance, but it is a question of vital importance whether a local company exists only to furnish light or to supply current for a variety of uses new and old.

In 1886 there were about 416 central stations in this country, of which 226 were then only doing a night arc-lighting business. Probably 325 were doing business only between dusk and daylight, and were standing idle the rest of the time; in other words, they were idle nearly two-thirds of the day the year through.

To what degree have these conditions been improved in the ten years? This is an extremely difficult question to answer, but a few tentative figures may be acceptable as a basis for study and discussion. At the close of 1896 there were about 2400 central stations in operation in this country, so that in ten years the number had increased sixfold, a gain that is simply stupendous. Of these 2400, however, 975 had, from the figures obtainable, no day circuits, and 220 others had only arc apparatus, so that 1195 local companies, by their own admission, were limited to night work. The case is not, however, so encouraging as might be implied from these figures. Of the remaining 1200 companies, only 327 report day circuits, and if it is safe to assume that half of the 900 companies and plants not giving these details were without day circuits, it would appear that, out of 2400 local plants, at least 1500 are limited to the night hours for their earning capacity. It must be noted, however, that nearly all the 900 companies not specifying day circuits are operating incandescent circuits, very largely with the alternating current, so that the means for day operation are generally there under more or less favorable conditions.

It is obvious at once that an immense amount of capital and machinery is standing idle that might otherwise be productive of profit and dividends. Of the 1200 companies confessing that they have no day circuits, only some 780 give their figures of capital and generating capacity in steam or water. It would appear that these plants, with a moderate capitalization of $46,908,000, and with an engine and water-wheel capacity of 164,000 horse-power, are standing idle two-thirds of the day, and often a great deal longer.

During the past ten years four new factors have presented themselves for the consideration and approval of the central station manager. These are motors, alternating-current supply, storage batteries and electric heating. The alternating current is, for most stations, still restricted to night work, and will be probably until more single-phase motors of a successful character are on the market.

What is possible in the direction of motor work is best judged from what the large stations do, and although in some respects this is an erroneous guide, it indicates the actual possibilities, even for a lower plan of execution. The following are figures of a large Western central station, showing the horse-power of motors connected to the circuits, and the percentage that the power consumption bears to the total output. The data come down to March 31, 1897:

LOW TENSION.

Power connected April 24, 1897	5396 horse-power.
Power per cent. of the total output	23.1 per cent.

HIGH TENSION.

Five hundred-volt power connected April 24, 1897	1566 horse-power.
Power per cent. of high-tension output	21.4 per cent.

ALL SYSTEMS.

Power connected April 24, 1897	6962 horse-power.
Power per cent. of the total switchboard output	22.8 per cent.

The work of the New York Edison station is also given as an example. On January 1, 1896, the total installation of motors supplied by that company from its distributing mains amounted to 11,640 horse-power, and on January 1, 1897, the motors connected were the equivalent of 15,930 horse-power, an increase of 36 per cent. The average size of these motors is from 3½ to 4 horse-power. Of the total motors connected, it is estimated that about 5000 horse-power equivalent is installed in connection with direct-electric elevators and grip hoists. He did not wish it to be understood, however, that the big companies are monopolizing the power business; it is open to all. He mentioned the fact that in Massachusetts, where there is only one large city, no fewer than eight companies out of fifty-eight are supplying power from arc circuits, eighteen from incandescent circuits and twenty-nine from independent power circuits, the total being about 14,000 horse-power of motors from the circuits. The asking rate per kilowatt hour averages about 20 cents, but runs down as low as 10 cents.

Touching storage batteries, Mr. Martin stated that there were only fifteen central stations in America using storage batteries, with a total capacity of 25,000 horse-power output. Four other stations are being equipped. What batteries can do is best exemplified in the Duane Street station of the New York Edison Company, one of the biggest stations in the world, with an engine and generator capacity of 20,000 horse-power. The load during the minimum hours, I am told by Mr. J. W. Lieb, Jr., the general manager of the company, is such that it can be supplied in that period from the storage battery annex, at the Bowling Green Building, in the southern tip of the tongue of Manhattan Island; or from the storage battery plant at the Twelfth Street station, either alone or in conjunction with current supplied from the Twenty-sixth Street station over the feeder-tie lines. The supply of stored current from the batteries in the annex stations during the minimum hours enables the big Duane Street station to be shut down every night from 10:30 P. M. to 5 A. M.—nearly seven hours; and on Sunday the operation of the generating machinery at Duane Street is limited to one watch.

Referring to the subject of electric heating, it is said that with current sold on the basis of 20 cents a kilowatt hour, no business can be done in heating, and that even if the price be cut in two, the inducement to possible customers is not great. If this were true, the matter of price of current might forbid the operation of a single fan motor from central stations. Making a rough calculation of 1 cent per hour for the ordinary fan motor, that is 10 cents a day for ten hours' steady running, or, say, $3 per month, or $36 a year. Allowing twelve such motors to the horse-power, the local companies are selling current to thousands of willing customers in the summer time at the rate of $430 a year per horse-power for a working day, or only ten hours. Other quotations can be made showing the high price readily obtained for current in small quantities from purchasers who are perfectly satisfied with the bargain and find it pays them also very handsomely in some element of comfort, pleasure, convenience or even economy.

A test taken three years ago for twelve weeks, of current consumed in cooking a dinner of several dishes daily for a large number of persons, showed that the current fell as low as 307 watt hours per person. At 10 cents per kilowatt hour, that means an expense of $3 per day, or, say, $90 per month. It will, of course, be objected, that in a great many isolated plants, the current made on the spot does not cost to exceed 5 cents per kilowatt hour, which would, in the building where the test was made, have brought the sum down to $45. A comparison between this and an equal amount of work on a gas stove shows that the outlay for gas in cooking, under equal conditions, would be between $90 and $100 per month, or about as much as electricity would cost if the current were supplied at 5 cents per kilowatt hour. This, Mr. Martin thought, was a very encouraging showing for electricity. The art of electric cooking, however, was sadly tentative and experimental, but he thought it was the duty of local lighting companies to go into the matter and see how far they could foster the new art by introducing the apparatus and furnishing current for it cheaply.

Much interesting data had been submitted by Mr. James I. Ayer, ex-president of the association, giving a great deal of information as to the work that has lately fallen within the practical attention of that gentleman, as representative of a large electric heating corporation. The work includes shoe-making machinery, heating silk-finishing rolls, leather-working machinery, and curling irons in many of the large hotels throughout the country, as well as on the American Line steamers crossing the Atlantic. Besides these, there were 14,000 car heaters installed, of one make alone, during the past year and a half, and electric glue pots, electric irons, vulcanizers, etc., are used to a very great extent in factories of all sorts all over the country. It is simply impossible that all this apparatus should have been put in unless it was economical or practically worth while. Surely, here lies opportunity of the largest kind to help the introduction of apparatus that must serve as a large customer for current at all seasons of the year.

The Es ablishment of a Base Price for Current.

At the Niagara Falls Convention of the National Electric Light Association, Mr. J. B. Cahoon read a paper on the title subject, which was full of interest to central-station men. An abstract of this paper, considerably condensed, appears below:

How many stations outside of the larger cities, he asked, find incandescent lighting profitable? Could they survive upon the incandescent lighting that they do, combined with the power furnished for stationary motors? He thought not. To bring incandescent lighting up to as profitable a basis as arc lighting was a serious problem. Certain classes of stations are still giving flat rates in many instances, and the solution of the problem for them is to change off to meters and make the meter price one that will be equitable both to the company and to the consumer. It occurred to him that it might be wise for the convention to adopt what may be called a standard rate, based on some factor or factors that will admit of application to every station in the country.

A careful analysis of the prices paid per kilowatt hour for incandescent light in different sections of the country seems to show that in many instances prices charged are based upon what somebody else has charged, rather than what ought to be charged, in view of the cost of the principal items entering into the operating expenses at each particular place. The two main factors that enter into the operating expenses are wages and coal. Coal is the one that shows a decided variation, and is the principal one in the cost of producing current. A glance at prices paid for coal in different sections of the country shows a very wide variation, and wide differences are shown in the evaporative power per pound of coal. These variations ought, strictly speaking, to enter as a factor in determining price, and, in order to get accurate results, should be so used, *i. e.*, placing the evaporative power of first-quality coal at 12, then the price paid for coal should be multiplied by the ratio between 12 and the evaporative power of the coal used, to determine the principal value for comparison.

In determining the base price which should be charged per kilowatt per hour, it is necessary to start with some kind of coal at a certain price, and which enters as a certain per cent. into the operating expenses.

For this purpose bituminous coal, with evaporative power of 12 and price $2 per ton delivered at the bunkers, has been taken, and it is assumed that with this coal at the price mentioned, it enters as a factor at practically 25 per cent. of the total cost of operating expenses of the company, said operating expenses including every expense attendant upon the production and distribution of the current and the administration of the company; also including taxes and insurance, but not expenditures for wiring of buildings or fixed charges. For example:

Assuming cost of operating expenses at $40,000, cost of coal as $10,000 at $2 per ton, we obtain the cost of coal as 25 per cent. of operating expenses. This gives one point of a curve which may be plotted for showing the effect of variations in the price of coal, other expenses remaining the same. Going further and plotting a curve on this basis, if the price of coal is $1 and other expenses remain the same, we then have the total cost of operating expenses as $35,000, of which coal is $5000, or 14.28 per cent. If coal is $4 per ton, the operating expenses are increased $10,000, and total operating expenses become $50,000, of which coal costs $20,000, or 40 per cent. In a similar manner, using other per cents., other points may be determined and curves drawn through these points, the curves partaking of the form of a parabola passing through the origin, the division of the scale of ordinates being dollars, and of the abscissae per cent.

If, now, we fix on 20 cents per kilowatt hour as the price which the consumer should pay on a basis of coal of evaporative power 12 and price $2 per ton, then if the same quality of coal can be obtained for $1 per ton, the price per kilowatt hour should be multiplied by one minus the per centum corresponding to the price of $1 per ton, or $20 \times (1 - .1428) = 17.144$; and if the price of coal be doubled, or $4 per ton, the price per kilowatt hour should be $20 \times (1 + .40) = 28$; the rule being to make the price, where fractions are obtained, the nearest whole number; thus, coal at $1 gives 17 cents per kilowatt hour. Similarly, the price that we should charge for arc lighting and power should be referred to the same standard. It should be clearly understood that the above assumption of coal at $2 per ton, and entering as 25 per cent. of the total operating expenses, is only made for the purpose of obtaining a starting point to present this idea to the members of the convention. In order to work out a satisfactory curve, and one that will fit the conditions of individual stations, each must figure out what per cent. of their operating expenses coal would be if they had to pay $2 per ton for standard coal, and start with this per centum as a basis on which to determine the proper curve for their own particular case.

Suppose each station were to make such a curve, and from it work out for itself the price which it should charge for current, and compare the price so obtained with the price that it is actually getting. This would then show whether the price should be advanced, in order to show a fair margin of profit. This is offered to the convention as a suggestion for the purpose of bringing the subject up for discussion and for determining whether, in the opinion of the convention, it is advisable to establish such a basis, and, if it is wise to so establish a basis, whether it should recommend its adoption to the members.

Intimately connected with the price that should be charged, is the determination of the cost per kilowatt hour. Each station has certain blanks which they use, largely with the view of enabling the superintendent or manager to determine the output and its cost, and it seems to me that the question of such blanks offers a fruitful theme for discussion. There are numerous blanks used in many stations that are merely for the purpose of keeping track of supplies, etc., and of which it is not necessary to treat, as each station manager has his own ideas on this subject, and they concern no one but his own company; but the question of blanks for showing output of the station and its cost is one that may well be discussed by the members of the convention, and an effort should be made to secure a standard set of blanks that will show these points in such a clear way that the information may be available for comparison and discussion in the conventions.

Report of the Committee on Data.

The Committee on Data of the National Electric Light Association, in accordance with instructions from the last convention, confined its work during the past year to the personal investigations of an expert, and not to obtaining information by correspondence, as was the previous practice. The expert employed for this work, Mr. F. R. Low, made an interesting report to the committee, which report was submitted to the Niagara Falls Convention. According to the report, the losses in electric light station practice due to the wide difference between the minimum and the maximum loads are possibly overestimated. Regarding the boiler losses, the report points out that when a boiler is laid off it becomes a drag, the coal used in maintaining the fire in a condition to be started counting for nothing, so far as steam production is concerned. The engineer of a Philadelphia station on a test found that it required 1200 pounds of buckwheat coal to keep up a pressure of 125 pounds on two water-tube boilers, having each 59 square feet of grate surface. This was .424 pound per square foot of grate surface per hour.

A five-days' test of a horizontal tubular boiler showed a consumption of .35 pound of coal per square foot of grate. Another water-tube boiler in a five-days' test used .5 of a pound per square foot of grate.

A Lancashire boiler with mechanical stokers used only .2 of a pound of coal per square foot of grate on a seven-days' test.

Two other water-tube boilers, one on a seven-days' test and the other on a test of several days' duration, used, respectively, .7 and .5 of a pound of coal per square foot of grate.

In each of these cases the boiler was shut off from the main and no steam or water taken from it. The coal was used simply to maintain the pressure. A moderate rate of combustion is 12 pounds per square foot of grate per hour. Allowing .5 as the average consumption while standing, the coal burned by a boiler in this way would be 4.17 per cent. of that burned while running at 12 pounds per square foot of grate for the same length of time.

If a boiler runs sixteen hours a day at an average rate of 12 pounds of coal per square foot of grate per hour, and stands the other eight with a consumption of .5 of a pound per square foot of grate per hour, the coal used, while idle, will be 2.04 per cent. of the whole. If it runs half the time, the expense in coal, while standing, will be 4 per cent. of the total amount. The following

table gives the percentages for different lengths of running and different rates of combustion:

Hours Running.	Hours Standing.	Percentage of Total Coal Used in Idle Boilers at .5 of a Pound per Square Foot of Grate While Idle.				
		Average Rate Combustion per Square Foot Grate While Running.				
		12	15	18	20	24
23	1	.18	.15	.12	.11	.10
22	2	.38	.30	.25	23	.19
21	3	.59	.47	.40	.36	.28
20	4	.83	.66	.55	.50	.41
19	5	1.08	.87	.66	.05	.55
18	6	1.37	1.10	.92	.83	.69
17	7	1.69	1.35	1.13	1.02	.85
16	8	2.04	1.63	1.37	1.23	1.03
15	9	2.44	1.92	1.64	1.48	1.23
14	10	2.89	2.33	1.99	1.75	1.44
13	11	3.40	2.73	2.30	2.07	1.70
12	12	4.00	3.23	2.70	2 44	2.04
11	13	4.69	3.79	3.18	2.87	2.40
10	14	5.51	4.46	3.75	3.38	2.83
9	15	6.50	5.26	4.42	4.00	3.35
8	16	7.69	6.25	5.26	4.76	3.85
7	17	9.19	7.41	5.96	5.79	4.87
6	18	11.11	9.09	7.69	6.98	5.88

It has been a matter of surprise, in following out this investigation, to find so moderate a difference between the performance of the boilers reported for long periods under widely varying capacities, and charged with all the coal used for banking, etc., and their normal efficiency under test conditions. This difference is shown in the following table, where the "test duty" is the best result obtainable under the best conditions with the fuel used; the "actual duty" is the number of pounds of water evaporated in a long term of service, divided by the coal used in the same period.

The third column is the ratio of the actual to the test efficiency, showing how badly the efficiency was impaired by the conditions of actual service.

With the exception of No. 11, the apparently low efficiency of which was due to a low grade of Western coal, these results are surprisingly high:

No.	Test Duty.	Actual Duty.	Ratio Actual to Test.	Per Cent. Short of Standard.	Hours Run per day.
1	8.58	8.009	94.5	19.91	24
2	8.68	7.302	84.1	26.98	6-12
3	9.96	8.02	8.05	19.8	24
4	.....	7.5	.....	25	24
5	10.5	9.96	94 6	4	23
6	.....	10.00	95.24	.....	24
7	7	6.14	87.71	38.6	24
8	.....	6.04	.....	.....	14-20 Av., 17
9	11.2	9.83	87.71	12	24
10	10.8	9.85	97.72	8	24
11	.....	5.75	.....	42.5	24
12	.....	11.36	.....	13.60	24
13	.....	7.50	.....	25.00	14
14	.....	9.00	.....	10.00	24

In comparing the duties attained in practice with the high standard established, the report continues, it must not be forgotten that the standard was attained with one of the best steam coals procurable, with less than 6 per cent. of ash-pit refuse. The results which we are comparing with this were obtained in many instances with coals having a much lower evaporative value per unit of weight, while their evaporative value per unit of cost may have been higher. Where the grate surface is ample, a very cheap grade of fuel can be used with a considerable reduction of the cost, and it is suggested that an economical advantage may arise from using two grades of fuel in plants that run long hours with widely varying loads; a good steaming coal with which the boilers can be forced at the time of overload, and a cheap small coal which can be used to advantage on the otherwise spare grate surface when the load is below the average. The fourth column of the table shows the percentage of difference between the results actually obtained and the standard, 10 pounds of water per pound of coal, and is the percentage accounted for by the various causes affecting the boiler efficiency. The efficiency of the boiler demands special consideration, for it affects directly the whole efficiency. Inefficiency in an engine affects only the steam which it uses, but inefficiency in a boiler affects the cost of all the steam produced for all purposes.

After briefly considering the losses due to impaired condition of engine, Mr. Low refers at length to engine losses due to unfavorable load. The station that has a constantly changing load, he states, is at the worst disadvantage from inadaptability of units. The "load factor" proposed by Compton, expressed by the ratio of the area within the load-line to the area of the containing rectangle, is not a fair expression for this disadvantage; for of two stations, each having a "load factor" of sixty, for example, and one running six-tenths of the time on uniform load, and the other all the time on a constantly changing load, the first will be at a decided advantage in this respect. Its units, if adapted, to their output, can be run at their maximum efficiency, and the station is better off even than a cotton mill, or other factory with a steady load, for it has a long run without interruption. It is to the fact that its load-line approximates more nearly this condition that the exceptional efficiency of the Brooklyn Edison No. 2 Station is due, and that an arc station is able to run at a less coal cost per unit of output. With a changing load, however, the units are at their maximum efficiency only momentarily. By plotting the engine blocks into the actual load-line as they are plotted into this conventional line, and as they have been in the actual load-line submitted from the Brooklyn station, it can be determined how much and for what proper-consumption curves for the given type of engine, the effect of such unfavorable loading may be estimated.

The report then calls attention to losses due to leakage, which losses are probably greater than is generally supposed. At one of the stations visited the leaks were about 2000 pounds per hour in the winter time, and in the summer, with one-half the engines, two-thirds the boilers and all the heaters shut off, they were about 500 pounds per hour; in another they were 3500 pounds per hour.

When it is remembered that, with the high-class engines which we are considering, 13 pounds per hour represent a horse-power, it will be seen that this leakage may account for a considerable proportion of the difference between the ideal duty and that reported as actually attained.

Attention is called to the losses in the condensation of steam in its passage from the boilers to the engines, and to the extravagant uses of steam by auxiliary engines.

The heating of the station as the result of unavoidable radiation constitutes an additional drag on the efficiency of the station in kilowatt hours per pound of coal is also referred to, and the steam used in getting a large engine ready for work is no inconsiderable amount.

The following table is given, showing for the few stations from which reliable data have been procurable, the proportions which the various demands upon the coal pile bear to each other and to the whole. The column headed "efficiency" shows the percentage of the coal actually used that would have been used by the standard equipment (10 pounds of steam per hour and the electrical horse-power .85 of the indicated). Under "engines" is the percentage of the total coal consumed by reason of the lesser efficiency of the engines; under "conversion," the percentage of the coal consumed by reason of the conversion losses exceeding the standard. The next three columns give the percentage of the total coal used to supply leakage, condensation and auxiliaries. The column under "boilers" gives the percentage by which the consumption was affected, by reason of the fact that the boilers evaporated more or less than 10 pounds of water per pound of coal, while the column of "unassigned" gives the aggregate of all the losses not separately reported.

No.	Hours. Run.	Results.		Efficiency per cent.	Percentage of Coal Used for						
		Lbs. Coal per kilow't Hour.	Watt Hours per lb. Coal.		Engines.	Conversion.	Leakage.	Radiation.	Auxiliaries.	Boilers.	Unassigned.
1	24	8.30	120.5	24.09	20.95	.24	.....	.....	.....	19.91	34.79
2	6-12	6.24	160.3	32.05	27.30	3.63	.....	.....	.....	26.98	10.04
3	24	3.71	269.5	53.91	9.03	.....	11.63	.....	.....	19.98	5.45
4	24	4.56	219.7	43.86	5.88	2.13	<—12—	>	.....	25.00	23.11
5	23	8.69	115.1	23.01	24.07	6.95	.....	.....	.....	.4	32.66
6	24	3.82	262.	52.10	8.80	5.03	.....	4.00	.....	.....	30 07
7	24	8.91	112.2	22.45	22.56	5.50	.....	.....	.....	38.60	10.89
8	14-20 Av 17	8.67	115.3	23.07	.....	.....	.....	.....	6.04	39.60	31.28
9	24	6.64	150.6	30.12	30.12	21.50	.....	.....	.....	1 70	17.56
10	24	8.62	116.	23.20	24.12	7.5	.....	.....	.....	1.50	43.67
11	24	10.13	98.7	19.74	9.27	.....	.....	.....	.....	42.50	28.49
12	24	7.45	134.3	26.85	38.22	.....	.....	.....	.....	13.60	48.53
13	12	7.33	136.5	27.29	11.45	.....	.....	.....	.....	25 00	36.26
14	24	5.68	176.2	35.21	10.64	1.07	.....	.....	5.30	10.00	37.77

Report of the Committee on Safe Wiring.

The report states that the efforts of the committee to bring about the establishment of a uniform standard set of electrical rules governing all electrical installations to be enforced by the fire-insurance companies and municipal-inspection bureaus, met with fierce opposition from some and indifference on the part of others. The principal obstacles to be overcome were:

First, indifference on the part of those most deeply interested—those engaged in electrical industries.

The next obstacle was the prejudice of the average underwriter against electricity when introduced into the property he insured. Gradually, fire-insurance associations appointed one or more inspectors to examine the electric-light wires, lamps and fixtures installed in their territory, and enforce certain rules and requirements, generally made by themselves. With the rapid advance of the electrical industries changes in these were inevitable, but lack of uniformity proved to be a crying evil. The best and most reasonable requirements were formulated in the sections of the country where the electric light had found a foothold earliest. Most of the inspectors, instead of profiting by the experience of those longest in the business and adopting the rules formulated by them, insisted on issuing productions of their own, so that the so-called insurance rules differed as widely as the excise laws of Maine and New York.

The loss of time and money caused by conflicting requirements became so great in time that a movement was inaugurated by this association for securing uniformity of rules—a codification of the best and repeal of the productions of cranks and impracticals. This task was accomplished by your former committee, the results of their labors approved, and the first national code issued by this association. It was also adopted by the insurance associations, who thus recognized the good work performed. After the issue of this national code it was thought that all the troubles here described were ended; such, however, was not the case, for while the best representative men of the fire-insurance associations agreed that the electrical engineer or electric-light superintendents were the proper ones to formulate the rules and requirements, and the insurance associations should enforce them, there were others, holding subordinate positions, who could not bear to have this sentiment put in practice. A result of such feeling was the organization known as "The Underwriters' National Electric Association," which has claimed the sole right to issue new or amend the original rules first issued by this association, and has in the past insisted that the electric and allied interests should have no voice therein. As time rolled by and the organization increased in numbers, this sentiment has changed somewhat, due to the influence of broad-minded, practical men, who are members of it, and to the efforts of your former and present committees, and last, but not least, to those of the National Conference on Standard Electrical Rules, which was organized through the untiring efforts of the chairman of the Committee on Standard Rules for Electrical Construction and Operation, Mr. W. J. Hammer, and his associates.

As a result of our combined efforts, the last codification of and amendments to the national code is the result of the combined efforts of the National Conference on Standard Electric Rules and the Underwriters' National Electric Association. The right to do this is what your committees have contended for in the past, and have finally obtained. Your present Committee on Standard Electric Rules selected its chairman to represent you in the National Conference on Standard Electrical Rules, which was organized at a meeting held in the City of New York, on March 18 and 19, 1896, of representatives of insurance, electrical and kindred interests. That body appointed a Committee on Code, consisting of seven members, one of whom was your representative; to this committee was assigned the task of amending and codifying standard electrical rules. At the time of the last meeting of the National Conference upon Standard Electrical Rules a large amount of work was done by representatives of the various electrical, insurance, architectural and allied interests, tending toward the adoption of the one single-standard code of rules. A pamphlet had been prepared embracing the various codes used most extensively in this country and abroad; and after these had been in substance considered, and many changes, omissions and additions suggested, it was deemed desirable that the results of the two days' careful discussion should be handed over to a special committee of seven, with the president a member ex-officio, which committee should draft a code based upon the lines suggested, and then refer the same back to the conference for its approval.

Since the meeting of the conference, the committee has, by meetings and correspondence, carefully taken up the work assigned to it. The most important meetings were held October 16 and 17, 1896; and December 11 and 12, 1896. At the October meeting it was decided that the committee, through one of its members (Mr. Merrill), should submit the draft already prepared by it to the annual meeting of the Underwriters' National Electric Association, to be held on December 8 and 9, to secure the benefit of the latter's criticisms and suggestions, and with a view of insuring a hearty co-operation upon its part. It was arranged that a joint meeting should be held of our Committee on the Code and a committee from their association to facilitate the preparation of the final draft of the code. This meeting, held in December, 1896, was very successful, and it was jointly agreed by the two committees that the title of the new set of rules was to be (1), The National Electrical Code (2), that the National Board of Fire Underwriters in printing the code would give, on the inside of the cover, due credit to the National Conference for its work, and place upon the cover the names of all the associations forming the National Conference, as fast as these bodies gave their indorsements of the code (3), that as far as possible the code should be left in the form as then presented, save that the classification as recommended by Mr. French be tentatively adopted, and after being set up by the printer, be resubmitted in "dummy" form for final consideration by the members of both committees. The members of the Code Committee of the National Conference, having met in New York May 19, 1897, passed the following resolutions:

Resolved, That each delegate who attended the National Conference on Standard Electrical Rules be sent a copy of the Standard Electrical Code, stating that said code had met with the approval of the Code Committee of the National Conference and the Code Committee of the Underwriters' National Electric Association, and stating the belief of our committee that there was no necessity for calling the conference together as a body again, entailing as it would a very considerable sacrifice of time and money, and requesting their immediate reply if they acquiesce in this recommendation and approve of the report submitted by the committee and by the president, secretary and treasurer of the conference itself. In the event of their objecting, and desiring that the conference as a body be called together as a body to receive the committee's report, answer is to be made within ten days, or their opinion is to be considered as favorable, and the code and reports published through the press by the Code Committee, and each delegate represented at the conference requested to bring the same formally before his association for approval. A meeting of the committee was held in Boston on the 5th inst., at which its previous action was ratified and the code as a whole unanimously adopted. The National Electric Light Association was the first to adopt and issue a national standard code of rules, and if it now adopts the new codification of them it will not only be indorsing the unanimous findings of its committee, but the unanimous action of the Code Committee of the National Conference on Electrical Rules, which conference was organized under the auspices of the association; but, furthermore, it will be the first body represented in the National Conference to do so, and your committee earnestly recommends that it gives its approval.

Magnetic High and Low Load Motor Protecting Devices.

In order to comply with certain inspection regulations governing the installation of electric motors in New York City, there have recently been devised a variety of electromagnetic devices intended to protect an electric motor from injurious effects due to excess currents which may result from overloading, or from starting the motor without a suitable resistance in circuit with its armature. As reported in the last issue of THE ELECTRICAL WORLD, the Edison Electric Illuminating Company of New York, in order to ascertain the actual capabilities of the various devices which have been brought forward for this purpose, arranged for a series of tests at the Duane Street station of all such apparatus submitted for the purpose. This test commenced on Wednesday afternoon, June 2, being continued on Thursday, June 3. A large variety of circuit breakers and automatic over and underload motor-starting boxes were submitted by the various manufacturers, among whom were the Automatic Circuit Breaker Company, American Rheostat Com-

pany, C & C Electric Company, Crocker-Wheeler Electric Company, Cutler-Hammer Manufacturing Company, American Electric Heating Corporation, Ward-Leonard Electric Company, Excelsior Electric Company, General Electric Company and Cutter Electrical & Manufacturing Company. Some of these concerns submitted several boxes of different designs.

The test was under the supervision of the company's electrical engineer, Mr. John Van Vleck, and Mr. Arthur Williams, inspector-in-chief, and was attended by representatives from the above-named concerns, the Fire Department Inspection Bureau and other interested persons. Mr. Alexander Henderson, chief inspector of the Fire Department Inspection Bureau, closely followed the tests, the principal objects of which was to designate such apparatus as complied with the rules of his department.

Included in the apparatus presented were two distinct types. The well-known form of electromagnetic circuit breaker, which, in its simplest form, consists of some magnet or solenoid device, whose armature or core acts upon a catch holding the main switch blades in contact with the clips against the action of a spring tending to open the switch. A modification of such overload automatic electromagnetic switch consists of an auxiliary underload attachment, provided with a separate coil and core, which, when released by the current in the core, operates the switch in a similar manner. The general arrangement and operation of such devices is well known. The largest number of the devices submitted consisted of automatic over and underload release motor-starting boxes, the majority of which embodied some form of rheostat, the contact or separate switch arm of which was held at the all-out point by an electromagnet connected, usually, in shunt across the line and releasing the arm when de-energized by a rupture of the circuit, or when short-circuited by a small series overload magnet fitted to the box and set for some predetermined amount of current above the maximum motor load.

In another form of automatic starting box submitted, the contact arm holding the magnet is differentially wound, one winding being in circuit with the armature, the other with the field, which is ordinarily effective. When the armature current exceeds the maximum the field-coil magnetization is neutralized and the arm released, as if the magnet had been de-energized by a rupture of the circuit. Various modifications of the above were also included. In some cases the main switch and rheostat are combined and arranged so that the switch cannot be closed unless the resistance is all in and is automatically opened at over or underload. One form of automatic switch arrangement shown consisted of a holding magnet for the switch blades which releases the blades when de-energized by an open circuit or a short-circuiting overload magnet.

The various appliances, of which there were twenty-five or thirty, were arranged on an asbestos-covered wooden framework. In making the test a 5-hp General Electric multipolar motor was used, which was suitably loaded by means of a prony-brake device. A 240-volt main was brought to the board to suitable switches and fuse blocks, and thence to the motor, to which each of the respective appliances was connected in turn and tested. The test consisted in gradually loading the motor and noting the point in excess of the maximum motor current at which the overload device operated, and in short-circuiting across the terminals to the motor to compare the relative operation of fuse and magnetic cut-out, it being desired to have the magnetic device protect the fuse. Each device was tried several times for each result, and it may be said that nearly all of them operated very satisfactorily, as far as the first test was concerned. In the short-circuit test most of the starting boxes operated almost simultaneously with the blowing of the fuse.

Profitable Extensions of Electricity Supply Stations.

In a paper read by Mr. Arthur Wright, of Brighton, England, before the Convention of the National Electric Light Association at Niagara Falls, that gentleman stated that notwithstanding the common impression that it is necessary in the electricity-supply business to take the bad consumers with the good, he maintained that no company should be called upon to supply electricity to anyone at a loss. He endeavored to show that it is quite possible to devise a simple and equitable tariff by which a profit is assured from each and every customer, and, moreover, that it is only by adopting such a tariff of approximately equal rates of profit from all that managers can hope to bring electricity into general use. He would also endeavor to show that electricity could be supplied at rates which, in most cases, would successfully compete with gas, while all the time yielding substantial profits. He thought that the field of domestic lighting in the homes of the great middle and lower classes was one of the largest and most fruitful fields to be cultivated. It was his firm opinion that while engineers have been devoting a vast amount of time and energy to considerations of coal and plant economy, they have neglected the readiest of all means for reducing the cost of supplying electricity, namely, such an adjustment of the tariff as to offer great inducements to the profit-yielding consumers, and insure that the unprofitable ones shall be charged as high a rate as is possible or expedient; a tariff, in fact, that will broaden out the average load curve of the station and so increase the usefulness of the investment.

It is obviously sound commercial practice in every line of business to encourage the profitable, even at the risk of losing some of the unprofitable business. Under no circumstances should the supply to short-hour consumers involve a loss to the supply station or increase the charge to the more profitable classes. If the principle of a sliding scale based upon the more or less prolonged use of the maximum demand is correct, then on every consideration of practice and of policy it should be applied to each consumer without distinction. A uniform charge for electricity limits its use to the few. The limitation of the use of electricity to the select few has also been aggravated by the highly pernicious system of giving large discounts to large consumers only, irrespective of their manner of consumption. Discounts on consumption per lamp fixed has the reverse effect of that intended, the author stated. In the first place, as the discount given under this scale is frequently inversely as the connected load, the consumer usually puts in only those lamps that he can use very freely, and the longer he runs them the larger will be the bounty in the shape of discounts. He knows very well, however, that if he fixes any less frequently used lights, his consumption per lamp and, consequently, the discount given him, will decrease, so he stops short of the number he would like to use, and electric lighting remains for him a luxury, strictly confined between the limits of certain business or social requirements. The economic disadvantage of this method of charging, then, is that it tends to contract the load curve and drive up the peak. The second objection is that in practice it is impossible to ascertain throughout the year with anything like accuracy, the wired capacity of all the consumers' premises and the third great objection is the unwisdom and expense of the domiciliary searches in private houses, hotels, etc., which this system requires.

Another system much in vogue, but having equally bad effects in stunting the profitable development of supply stations is the unsound practice of charging a higher price for electricity consumed in lamps than for that supplied to motors and other apparatus. For a *reductio ad absurdum* of this practice, we have only to compare the relative profitableness of a basement user of lamps with that of an elevator motor. The former is the steadiest and the longest consumer any manager can wish for, and the latter the most objectionable of all short-time users of electricity.

The author stated as his opinion that one of the most profitable fields for extension lies in the displacement of isolated plants, which to-day are frequently a worry to the supply stations by requiring connection to the street mains as a standby against accidents. It is well known that isolated plants are only installed where the demand for electricity is of a lengthy nature and by the application of an equitable sliding scale, this very profitable business can be secured to the supply station. He pointed out the results of such a tariff in Brighton, England, where since its adoption the business formerly handled by several valuable isolated plants had been turned over to the street mains and not a single new isolated plant had been put in.

On the same principle it is good business, he continued, to encourage consumers to install lamps which will be used at different times of the day and night, so is it most desirable, in extending the business of supply stations, to cater as much as possible for varied classes of consumers requiring electricity at different hours. From this point of view, considering the cases of a large early closing store, a theatre and a hotel, in which the bedrooms as well as the public rooms are wired. If each building is dealt with separately, we have three plants, each of which must be large enough to cope with the maximum requirements of its particular building. By combining the store and theatre installations part of the smaller plant of the two can be dispensed with, and if the hotel be added

to the combination, the resultant maximum requirements of the three will be the lowest possible.

It is very much better soon after starting the station, Mr. Wright said, to run mains in all parts of the town in which artificial lighting is used late in the evening, than it is to spend money on coal-saving refinements, or in running large mains to districts occupied by large early closing stores or by mansions of the wealthy. Both of these last-mentioned classes are very expensive to supply; the former make but a short daily use of the plant, while the latter are frequently absent from home and the nature of their demand is generally erratic. The author specially urged the true economy of a liberal supply of distributing mains, which can be made to serve the double purpose of supplying street lamps as well as the general public.

To test the profit-earning capacity of any electric supply station a correct method of determining the cost of supply is obviously required, and in this connection he presented a set of tables relating to the development of the station in the fairly representative town of Brighton. Columns were inserted giving the equitable charges that should have been made to the customers during each year on the alternative systems of charging advocated by the author. The first was based on the principle of charging stated amounts per annum per maximum kilowatt demanded by each individual consumer, and then charging all the electricity consumed (quite irrespective of the purpose for which it has been used) at certain other rates. The alternative tariff, commonly known as the Brighton system, charges a sufficiently high price per kilowatt hour consumed, until all the costs the company is put to in "standing by" have been covered. The fact of this system having been adopted in about thirty-five English towns, he thought, was evidence of its commercial practicability. On this tariff it is advisable to make the difference between the initial price and the reduced price as marked as possible. A high initial rate of charge per kilowatt hour or lamp hour maintained to each consumer, until the annual cost of getting the plant in readiness to supply the maximum wants has been covered, and a substantially reduced charge for the subsequent consumption forms the basis of a perfectly equitable tariff applicable to all stations and conditions of supply.

The only items in the tables which were found to vary with the amount of electricity actually sold from a given plant, were coal, stores, water and repairs. Should any managers find that their wages or other costs also vary on this account, it is easy to separate them into the proper proportions for "standing by" and actual running, by the simple method of analysis by differences, which provides a means for determining the cost a station is put to in having to supply each additional kilowatt hour from its plant It consists in dividing the difference between the amounts debited to the special account required to be so analyzed in the six winter and six summer months respectively, by the difference between the number of kilowatt hours sold in these two respective periods.

To illustrate how impossible it is for electricity to be supplied on a uniform tariff at so low a price as it profitably can be on an equitable sliding scale to the lamps used in the average house of the middle classes, it is only necessary to note, the author said, that in 1896, to have produced the same amount of profit, the uniform charge to this four-hour class must have been 9.3 cents per kilowatt hour as against 7.5 cents, or at an increased charge of 25 per cent. If we take the case of saloons and clubs, which keep open late throughout the year, and on the average run their lamps six hours a day, the uniform charge would have been 46 per cent. higher, and in the case of basement users running their lamps ten hours a day on an average throughout the year, the uniform charge must have been 70 per cent. dearer than it could have been supplied on the system of equal profits. On the other hand, the one-hour consumer, on the uniform system, would have been charged 9.3 cents. as against the proper charge of 17.86 cents per kilowatt hour, and as 15 cents would have been the actual cost of supplying this kilothe watt hour, the company would have lost no less than 6 cents for every kilowatt hour so sold.

In order to demonstrate very clearly the effect of the gradual improvement of the business on an equitable sliding scale of charges, the author has prepared curves showing how the varying charge per kilowatt hour, according to the number of hours the demand was used, has diminished in the various years, as managers have suggested that this necessity for a high initial rate will disappear with electricity being more generally used.

Frequency Transformation.

BY LIEUT. F. JARVIS PATTEN.

Transforming the frequency of alternating currents seems to be the only alteration of these exceedingly mutable forms of electric energy that has not yet become an industrial requirement; it is by no means certain, however, that it will not become one at an early day.

Three possible transformations of alternating current are evident in the nature of things; they are:

That of voltage from a higher to a lower E. M. F.

That of phase—from a given number to a greater or a less number of independent currents; and

That of frequency from a given periodicity to a higher or lower rate of alternation.

The first and most obvious of these was the *raison d'etre* and whole foundation, in fact, of alternating current practice.

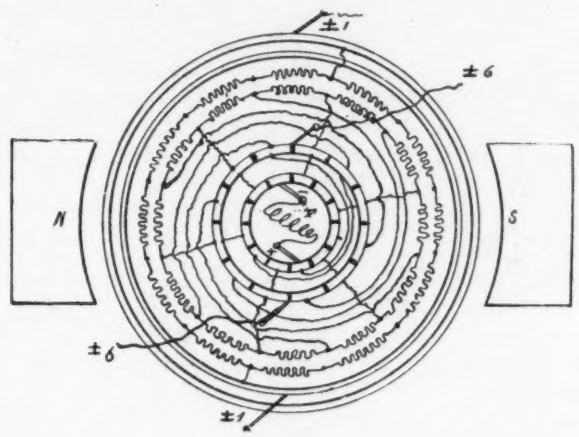


Fig. 1.

The second was but a tardy outgrowth of multiphase current working, and its efficacy and value were neither seen nor understood by its earlier inventors, no use being made of this order of transformation for several years after its first reduction to practice in 1892.

The third is now apparently going through the same embryonic stage of tentative solution, while electrical engineers are still at a loss to say to what extent frequency transformation will be used when a good solution of the problem is given. This, however, was precisely the case with phase transformation four or five years ago. the importance of which is comparatively recent knowledge.

One thing, however, is certain; at times we would like a comparatively high frequency for one use and another relatively low one for another on the same circuit, but at present we cannot have both

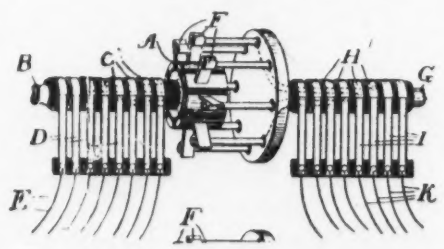


Fig. 2.

from the same generator; thus compelling a sort of compromise in the selection of the frequency that a system of distribution shall be given, and this necessarily to the disadvantage of some part thereof.

For power distribution we should prefer a comparatively low frequency for motors, rather below sixty than above, but so low a rate is not the best for writing; hence the compromise if both are to be operated from the same circuits.

Probably the chief reason why frequency transformation has not been more seriously considered is because no really good or simple solution of the problem has yet been presented; all thus far published being burdened with a complexity of commutating de-

vices, rings and revolving brushes that render such systems altogether objectionable.

I think I was the first to show a system of frequency transformation in a paper before the American Institute of Electrical Engineers in 1891.

The essential features of that system are shown in Fig. 1. Briefly, a gramme armature has a primary winding so connected to its commutator that it will turn through a certain arc, say, one-sixth of a revolution for each cycle of the alternating current, while a secondary winding of the same ring has two diametrically opposite points, connected each to a ring collector.

The system by which the primary winding is connected to its commutator makes such a motor self-starting with a single phase supply, and a second commutator, reversely-connected to the first at alternate segments, gives a direct current for the field excitation.

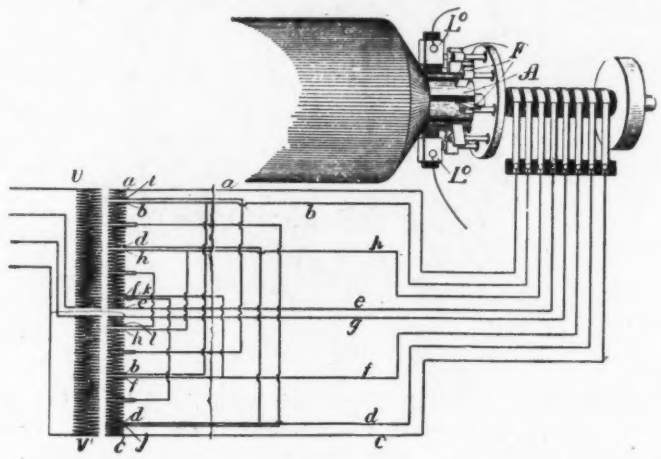


FIG. 3.

This apparatus will transform a single-phase alternating current of a given frequency to either single or multiphase alternating currents of one-sixth the given frequency. I need hardly say, however, that, simple as this may seem on paper, the two commutators render the device unacceptable to American practice, and no machine with even a single commutator or revolving brush can be regarded as a solution of this apparently difficult problem.

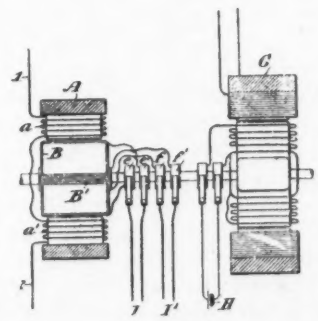


FIG. 4.

Since 1891 only five United States patents have been issued for frequency transformers. It will serve no purpose to refer to them here in detail. They all come under two heads: One has a multiplicity of revolving brushes and commutators with rings enough to make one dizzy, as evidenced by Figs. 2 and 3, taken from one of the patents; and the others are simply motor dynamo systems, and are not, strictly speaking, frequency transformers at all, such as that shown in Fig. 4, taken from another patent.

Both systems are self-evident in principle and operation. As concerns the first, it goes without saying that inasmuch as every direct current is built up of a greater or less number of alternating currents in multiphase relation, so, by a process of analysis, it is a simple matter to separate them in distinct circuits, and then, by a process of synthesis, it is equally simple to recombine them as we like to produce any new combination desired in the way of phase or frequency alteration. My earlier attempt, outlined in Fig. 1, was a little in advance of this.

Again, it is evident that if we have an alternating current motor of any description capable of giving power, it can be made to drive a generator of any sort of current or frequency desired; such makeshifts are not transformers of frequency, as I understand the term,

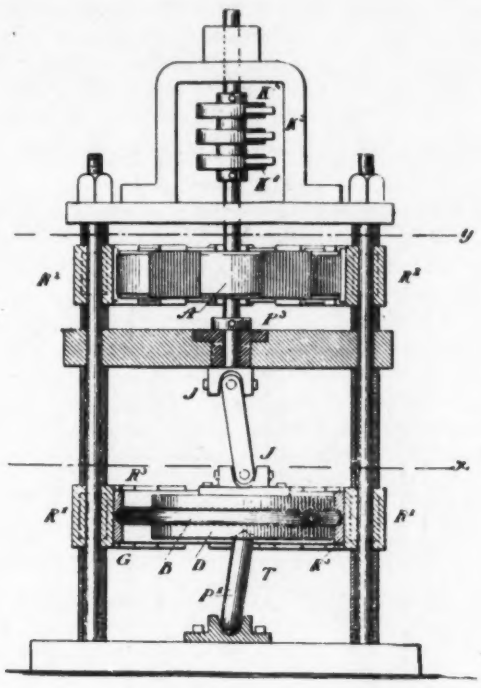


FIG. 5.

and before going further it may be well to define a frequency transformer as I conceive it.

Such a device should be a self-contained apparatus, in which all the parts are electrically or magnetically interdependent, the function of which is to introduce in a secondary circuit an E. M. F. of different periodicity from that of the primary or inducing circuit and source of supply. Inasmuch as frequency is always the

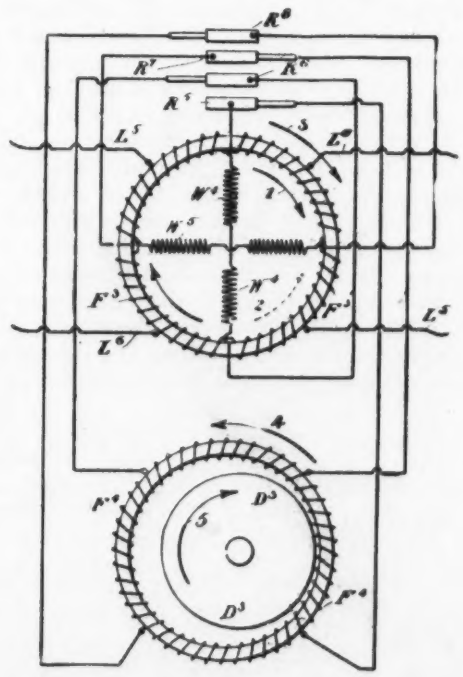


FIG. 6.

result of a relative motion of one part of a generating apparatus with respect to another, thus setting up a corresponding rate of change of induction, so it may be presumed true that changing the frequency of alternating currents implies changing the relative motion of inducing and induced parts with respect to each other, from

which it may be further inferred that a moving part is indispensable.

In the apparatus I shall now describe I obtain this change in the rate of induction by a novel form of electromagnetic motor, which is an independent part of the transformer system, and which, in conjunction with the currents of altered frequency, determines the degree of transformation. A brief description of this motor is necessary to a clear understanding of the apparatus. It is shown in vertical elevation in the lower half of Fig. 5, and in horizontal projection in Fig. 6. Its field consists of a toothed iron ring with

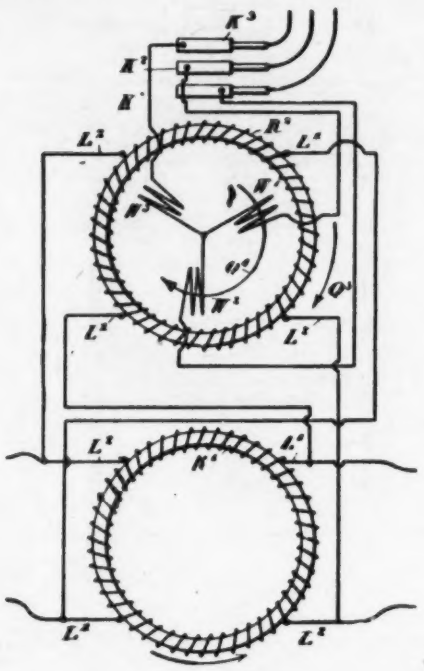


Fig. 7.

a gramme winding, supplied with multiphase currents through the leads L_1, L_2, setting up a rotating magnet field in the ring. The armature is a solid iron disc, D, Figs. 5 and 6, about the same thickness as the ring, but having a diameter considerably less. It has a raised rib or flange, B, which fits into and travels in a corresponding groove cut into the faces of the inwardly projecting teeth of the ring, Fig. 10, or in a track set in the ring, Fig. 6. This disc armature is pivoted, as shown, eccentrically to the field ring, with which it remains always in contact at one side of the inner periphery of the latter, and is supported by a spindle, P_1, which maintains the disc in stable equilibrium in any position it may assume within the ring. When the ring is energized the magnetism attracts the iron disc, and while holding it in firm contact against the ring at the side, it causes it at the same time to roll around the inside wall of the ring, following, as it must, the revolving polar line of the field. If, however, the rotating magnetism turns contra clockwise, the disc in rolling the same way will revolve in a clockwise direction about its own axis, as indicated by the arrows in Fig. 6.

Such is the motor part.

A universal joint, J, Fig. 5, serves the purpose of rectifying the eccentric movement of the disc, so that any apparatus carried by the upper spindle, P_3, will revolve concentrically with the upper ring, R_2, and this ring with its winding constitutes the primary or inducing element of the transformer, the three-coil armature, Figs. 5 and 7, with its three free ends connected to its three collector rings, Fig. 5, being the secondary element or induced circuit.

Such is the apparatus in its entirety, and it may be properly styled a motor transformer for voltage, phase and frequency, as all three functions can be performed as well simultaneously as one or two of them.

The essential peculiarity of the motor that adapts it to this use is the following: As the armature disc, D, has a smaller diameter than the ring inside which it rolls, so in rolling around the ring from a given starting point back to the same point again, the disc will have an entirely independent rate of rotation about its own axis, very different from that of the rotating magnetic field in which it turns, and which will be a function of the difference between the diameters of the disc and ring.

Here, then, we have the essential requirement of a frequency-changing apparatus, the operation of which will be somewhat as follows:

Fig. 8, being a diagram of circuits for reducing frequency, biphase currents from the source of supply are introduced to the upper or transformer ring winding, the leads being so connected as to set up a clockwise rotating magnetic field in this ring. Naturally, the transformer armature would rotate in the same direction (if

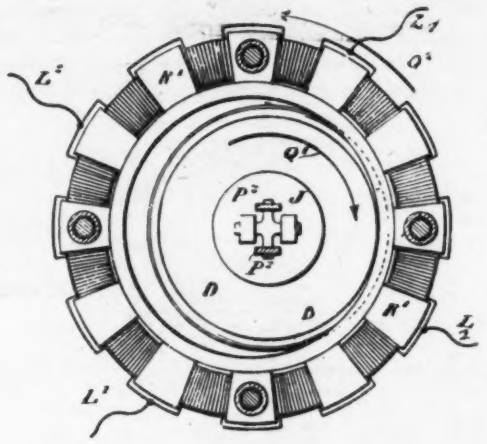


Fig. 8.

its circuits were closed) synchronously with the field, if free and unconstrained. If, however, the armature is not free, but is constrained to revolve at a slower rate, then multiphase currents (biphase in this instance) will be generated in its coils, having a frequency determined by the number of times the armature turns through the rotating magnetic field while the latter is making one revolution in space.

Let such constrained motion be assumed and consequent generation in the armature coils of multiphase currents, and let these currents be taken from the collecting rings and brushes thereon through leads down to the lower ring winding or motor field, the leads being so connected to this winding as to set up a contra-clockwise rotating field, or one opposite in direction to that of the transformer field above. This done, and the biphase currents from the source turned on, the motor disc will commence rolling around its ring in a contra-clockwise direction, but turning at the same time about its own axis in a clockwise direction, carrying the transformer armature with it in the direction of its own revolving field, as it would turn if free and unconstrained by the motor disc, but at a rate of speed of rotation identical with that of the disc about its own axis, which is much slower than the speed of rotation of the transformer field—the latter having a rate corresponding to the frequency of the biphase currents supplied to it.

We therefore have in this transformer system a rotating magnetic field of comparatively high speed in the primary ring winding, and an inclosed secondary circuit revolving within the latter at a comparatively low speed in the same direction. Under these conditions the induced secondary currents of the armature will have a frequency due to the difference of these two rates of rotation. One of them, that of the field, is given, and the other is the axial rotation of the disc—necessarily something less than that of its own motor field (when its diameter is more than half the diameter of the latter), and the latter being identical with the frequency of the transformed or induced currents in the armature coils. The disc acts as a sort of brake or load on the armature, holding its speed down below the synchronous rate, thus producing a slowly revolving motor field for the disc to roll in.

To increase frequency, a system of circuits like that shown in Fig. 9 will be found preferable. In this case, the biphase currents from the source of supply are introduced to both the transformer field and motor windings, and the connections are such that the transformer armature and disc will turn in a direction opposite to that of the field in which the armature revolves. In this case, as a matter of course, the induced secondary currents will have a frequency due to the sum of the two motions instead of their difference as before. The following is the general analysis of the two cases:

First, to reduce frequency by the system indicated in Fig. 8.

Let n = frequency of the primary currents.
n = revolutions per unit of time of the transformer field.
p = inside periphery of motor ring.
q = outside periphery of the motor disc.
From these it is required to determine:
y = revolutions made by the transformer armature in a unit of time.
y = rate or speed of rotation of the motor disc about its own axis, and
x = frequency of the transformed currents.
x = rate of rotation of the motor field.

Evidently, if the frequency is reduced, y will be less than n, and the transformer armature will turn $n - y$ times a second, which

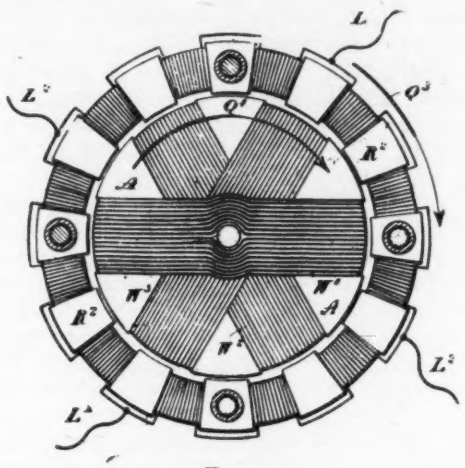


FIG. 9.

must therefore determine x, the rate at which the motor field rotates. Hence we have:

$$n - y = x \ldots\ldots (1)$$

$\frac{p-q}{q}$ is the measure of the difference of the ring and disc peripheries expressed in terms of the latter, and represents that fraction

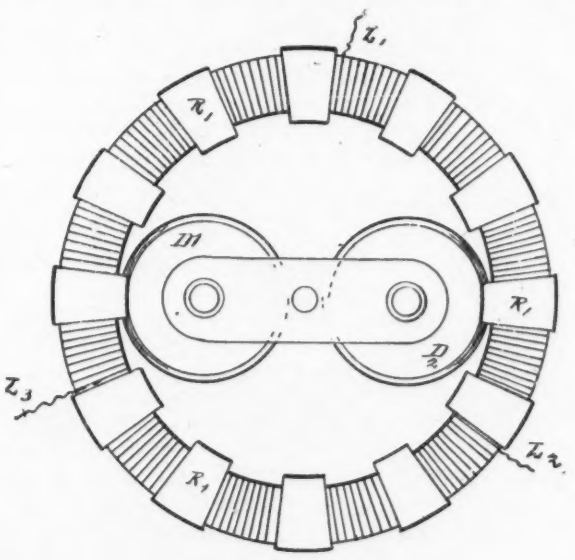


FIG. 10.

or part of a complete revolution that the disc will make about its own axis while rolling once around the ring or in the time that the motor field makes one revolution.

In the time, therefore, that the motor field makes x revolutions, the disc will make $x\left(\frac{p-q}{y}\right)$ revolutions, and this value must be equal to y, because the disc and armature are rigidly connected.

Hence, by substitution in equation, we have:

$$n - x\left(\frac{p-q}{q}\right) = x \ldots (2)$$

from which

$$x = \frac{n-q}{p} \ldots (3)$$

giving the frequency of the transformed currents in terms of n, p and q, known.

Suppose x is given and it is required to determine the diameter that the disc should be given to obtain this frequency with a given diameter of motor ring. From equation (1) we obtain

$$\frac{p-q}{q} = \frac{n}{x} - 1 \ldots (4)$$

For example, in the former case, let the primary frequency be $200 - n$, ring diameter $24 - p$, and disc diameter $8 - q$, then from (3) we have $x = \frac{200 \times 8}{24} 6.66$, or the transformed currents will have a frequency of 66.6, or one-third the frequency of the primary currents.

In the latter case, given a primary frequency of $200 - n$, a secondary frequency of $66.6 - x$ to determine what relative diameters to give the ring and disc to get this result we have from (4)

$$\frac{p-q}{q} = \frac{200}{66.6} - 1 = 2$$

whence $p - 3q$, or the disc to effect this transformation, should be one-third the diameter of the ring.

To increase frequency, the system of circuits shown in Fig. 9 is preferable. Here the primary currents from the source of supply are taken to both field windings, so that in this case y becomes n and $\left(\frac{p-q}{q}\right)$ and we have from (2), remembering that the two rates of rotation must now be added, $n + n\left(\frac{p-q}{q}\right) = x \ldots$ (5 is the transformed frequency, and is one due to the sum of the two rates of rotation field going one way and armature the other.

Thus, as before, let $n = 200$, $p = 24$, $q = 8$, then $x = 200 + 200\left(\frac{2}{8} - \frac{8}{8}\right) = 600$, or the frequency in this case will be three times the primary rate.

Fig. 10 shows a modified form of the disc motor, designed to insure strong magnetic action.

When the disc is nearly as large as its containing ring, one disc will answer the purpose, but when it is less than half the diameter of the ring, two diametrically opposite discs, joined by a yoke, should be used, thus making a perfectly closed magnetic circuit.

We have evidently here a comparatively simple apparatus, from which almost any desired frequency can be derived from a given frequency, while the system is entirely free from revolving brushes or commutators of any description, three collecting rings being, in fact, all that is essential for ordinary transformations of voltage phase and frequency, of which the system appears to be a general solution.

By having a variety of interchangeable motor discs of different diameters, a great variety of transformations can be made with the same machine.

I am aware that the analysis given for the determination of the transformed values is incomplete, inasmuch as it does not take into consideration the interactions between the two motor systems, the true analysis of which would doubtless prove a very intricate problem; the analysis given is based on the assumption that the disc motor runs normally, as if it were free and unloaded, and so drives the armature above. This will doubtless seldom be the case, and the speed of equilibrium to which the apparatus will finally settle down will be something in the nature of a compromise between the exertions of the two machines regarded as independent motor systems.

Three-Cent Fares Upheld.

The State Supreme Court of Indiana to-day upheld the three-cent fare law, the enforcement of which on the street-car lines of the city of Indianapolis recently caused much conflict and several small riots. The decision further complicates matters, as Judge Showalter of the Federal Court recently granted an injunction, on the application of the Central Trust Company, of New York, Eastern bondholders of the Citizens Street Railroad Company, holding that the operation of the law impaired the bond contract.

The State Supreme Court says that the Legislature undoubtedly had the right to pass such a law. It is believed that Judge Showalter will now modify his ruling, and that the case will be appealed to the United States Supreme Court at once.

Recent Progress in Arc Lighting.*

BY ELIHU THOMSON.

In recent years the tendency in series arc lighting with constant current has been to increase of voltage of the dynamo, and machines capable of working 125 to 150 arc lights in a series have been developed successfully. But the potential between terminals in such a case may be 7000 volts—often too high for security, and in some places forbidden by special legislation. An ingenious method of employing such machines when, as is the case with the Brush machine, several commutators are present in series relation, has been devised by Mr. Green, of the Brush Company. This plan demands that separate pairs of wires be run from the machine to the switchboard for each circuit, but the unquestionable effect of the new connection is to limit the difference of potential which is possible to be manifested between any two parts of the circuit through the machine and lamps.

In such a system, evenly loaded, the highest difference of potential anywhere to be found will evidently be that required to run a

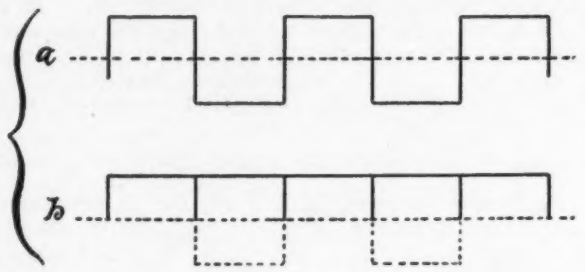


Fig 1.

series of lights looped between two successive commutators. If lights are cut off from any set or loop, the potential difference between the terminals of that loop falls accordingly without any corresponding or proportional rise between any other parts of the circuit. If, however, lights are cut off one set and added to another, so as to keep the machine in full work with unbalanced loads, then the potential distribution is, of course, disturbed, and the system approaches the condition of all commutators connected directly in series, and the lights all in one series—the old plan. Where the conditions of the circuits leaving the station are such as to permit inductional effects on parallel wires—such as those of a telephone system—the new plan of circuit connections may give, as appears to have been already noticed, a greater inductive disturbance. This must be owing to the relatively simpler commutation per loop of lamps. In the old series connection all the commutators in series acted virtually as one of many segments, which tended to give a smoother potential, or prevent waves in the potential of the line. In the new plan each commutator of few parts acts, in a measure, independently of the others, and impresses its own variations of potential more directly on the lamp lines, giving rise to electrostatic inductional effects.

The immediate future of the series arc lighting system appears to be in the development of large dynamos, up to, say, 300 arc lights each, running at such speeds that one or a pair may be easily coupled directly to the shaft of a moderately high-speed engine. The use of a regulated constant current in the series system, besides giving a simple system as to wiring, etc., is seemingly best adapted to the use of the cheaper carbons. For extended districts the series arc lighting system is still likely to hold its own, but displacement by constant-potential arcs and inclosed arcs on constant-potential circuits will doubtless continue in cities supplied by underground low-pressure systems with continuous currents.

Passing now to the consideration of the use of pulsating currents in arc lighting, it may be said that at present little or nothing has been done commercially in the United States in the use of such currents. The subject becomes one of importance in connection with what are known as rectifiers. These are machines that take an alternating current and commute the waves, or rectify them, so that the flow of current is in the same direction always, though rising from zero to a maximum for every alternation in an alternating current. The more or less near approach to continuity of current will depend upon the shape of the wave rectified. A rectangular wave, properly rectified, would, as in Figure 1, give a true continuous current. Other forms of wave give less continuity, depending on the sharpness of the individual wave peaks, *c*, *d*, Fig. 2. The character of arc produced by the rectified current resembles closely that of the continuous-current arc, in that the crater in the positive carbon is present, and the negative tends to point itself. There is, however, a strong note or sound evolved from the arc, depending for its pitch upon the periodicity or frequency of the alternating current. The inductional effects of the pulsating currents in lines upon neighboring lines will, of course, resemble those of alternating currents, though less musical than the latter when a sound results, as in a telephone. In order to make it easy to commute or rectify such a high potential of alternating current as would be needed to feed, say, a series of forty to fifty arc lamps with pulsating current, certain conditions are very desirable. One of these is that the current to be rectified should be of constant value, though alternating. The writer showed, nearly ten years ago, how a constant-current transformer could be made, using primary current at constant potential to obtain secondary constant current. One of the ways was to so mount a secondary coil, with relation to its primary, that repulsion might be exerted between them and so move one away from the other when a tendency to increase of current in the secondary took place. This method was found to be highly efficient, and was embodied in a number of forms of apparatus, some of which were employed to feed constant current to arc lamps in series. In this case lamps may be cut out and the secondary coil even short-circuited, while the current in it remains practically constant.

The above relates to the rectification of a single-phase current. When, however, two-phase or three-phase currents are to be rectified, there will be at least two or three constant-current transformers, one for each phase, and the secondary current may be combined through commutators resembling those of the Brush arc dynamo for the two-phase, and the Thomson-Houston for the three-phase. In such cases the resulting rectified current is much more nearly a steady or smooth current, and not so much of a pulsating character. This is, of course, owing to the relation of the phases being such as to cover each other's zeros or to overlap. Under proper working conditions there should be a certain field for the

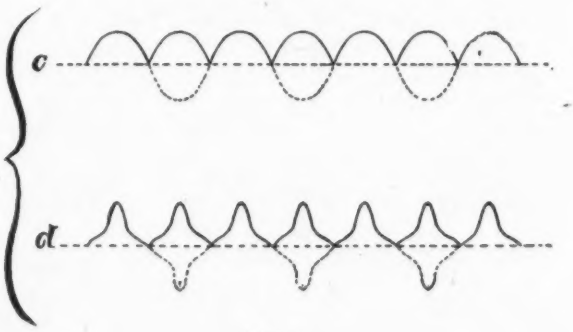


Fig 2.

use of rectifiers in the United States, as well as in England, where Ferranti has for some time past had some of them in use. It is difficult to adapt a rectifier to periodicities of as high as 125 per second, but with 60 periods the problem is comparatively easy. The use of rectifiers has the one great advantage of permitting the generation of current in a station to be by means of large direct-connected dynamos, a portion of the output of which is used in the ordinary way to feed lights, etc., through the usual constant-potential transformers, while another portion, feeding rectifiers, supplies the arc lamps of the system instead of special arc dynamos, while, if needed, the whole capacity of the generator may be utilized for one or other kind of load, as desired.

The arc lamps worked by rectifiers are like continuous-current arcs in giving the downward distribution of light from the positive crater, a feature of great value in street lighting. There is also complete regulation—such that lights may be cut out ad libitum by shunting, while the other lights remain unaffected. Furthermore, the efficiency of the rectifier is high, and may easily be made over 90 per cent.

*Abstract of a paper read before the Niagara Falls Convention of the National Electric Light Association.

Two or more arc lamps are now often connected in a branch across constant-potential mains or supply lines. Thus, on 110-volt circuits, two lamps using about forty-three to forty-five volts each, and with a proper choking resistance, may be found in the branch. On 220 volts there may be four lamps in a series, and on railway circuits of between 500 and 600 volts nine to eleven lamps may be found connected, with, in each case, a proper resistance.

The quality and character of the carbons used has a decided effect on the results as to steadiness and uniformity in constant-potential arc work. Hence, a good cored positive and solid negative are desirable.

The distribution of current for arc lighting at constant potentials has undoubted advantages, one of which is the relatively low tension and absence of danger. Another is the facility of installation along with incandescent lights, and ease in metering the supply. The loss of energy in the distribution may, at full load of lines and moderate distances from the supply station, be, say, 10 per cent. or more, chargeable chiefly to feeder drop, and about 15 to 20 per cent. in dead resistance in the lamp branch. We may take, then, 25 per cent. as an average loss in reaching the lamps. This loss, which is much greater than the percentage of loss on the series system, is yet largely, if not wholly, made up by the superior efficiency of the constant-potential, low-pressure generators of large capacity over that of arc machines of relatively smaller output, and by the higher engine efficiency which may readily be attained in driving large generators, especially when working with economical loads. It must not be forgotten, however, that for equally good results a better and more expensive carbon will be required for constant-potential work than for plain series arc lighting. These observations relate, of course, to ordinary open arcs with full supply of air reaching the hot ends of the carbons. The conditions existing with long-burning lamps or inclosed arcs will be alluded to later.

One serious objection to the arrangement of lamps in series between constant-potential mains, especially those of 220 to 500 volts, is the inflexibility, or inability, to cut off some lamps in a branch without substitution of equivalent resistance, which substitution, of course, means that the same watts are consumed whether the lights burn or not. We lose the advantage of the constant-current system, which enables us to shunt lamps and save power, and also that of the simple multiple arc or parallel system at constant potentials, in which each lamp is in its individual branch circuit. Open-circuiting the branch extinguishes the light and saves power. With alternating current at constant potential there is greater flexibility, but, unfortunately, no alternating-current arc lamp is likely to equal in its effects lamps making use of continuous currents or undirectional currents.

There are two ways in which alternating currents may be used to work arc lights in series. We may either take a constant-potential system, such as one with main lines at 1000 volts and connect between them a series of arc lamps at about thirty volts each and about thirty-five lamps, or we may transform so as to feed the lamps in series with a current of constant value, or with a current which does not vary more than a given per cent. from light to full load—15 per cent. for example. In the former arrangement some provision must be made to allow lamps to be extinguished without breaking the circuit, and this cannot be done by shunting unless equivalent resistances be substituted, for the shunting of a lamp or lamps in a series would result at once in a great increase of current in the others and a serious departure from normal working.

By shunting each lamp in the series by a specially constructed and carefully proportioned reactive coil, wound upon a laminated core, the difficulty just pointed out is obviated with but small sacrifice.

When a transformer is so constructed that there may be a considerable magnetic leakage, as it is termed, between the primary and secondary coils, it approximates what is called a constant-current transformer. It will, if connected by its primary terminals across mains at constant potentials, give a secondary current which, even at short-circuit, is only a moderate percentage in excess of that given when the secondary is carrying a considerable load.

In fact, such a transformer has an analogy which is unmistakable, to a direct-current arc machine with a drooping characteristic, before alluded to. When, however, the amount of magnetic leakage in the transformer is carefully proportioned, or when, as in the rectifier transformer with repelled movable coils, the leakage is allowed to adjust itself, a substantially unvarying value of alternating current is delivered at all loads from short-circuit up to the full load, or highest available working potential. The transformer then resembles an arc machine with an instantaneously acting and perfect regulator, or such a machine with a characteristic curve which droops vertically. This would mean the preservation of the same current at all potentials. By properly proportioning an alternating-current dynamo, the same property of constant current has been given to the machine.

For arc lamps in series on alternating current, this constant-current property is perfectly adapted. But in this case the regulation of the lamp must be by a shunt magnet responding to the potential across the arc, and not to the current passing through it, which is constant. Of course, the shunting reactances before mentioned might be used, but these would have no particular function in this case, since the system of supply permits free shunting of the lamps, and the current is the same even down to short-circuit. Numbers of lamps were installed several years ago by the Thomson-Houston Company and worked in the way indicated, the transformers being of approximate constant-potential property, but the writer does not know to what extent they are still in use. That the system is not entirely dead was indicated by a recent demand for additional transformers of the same type, though for quite a period none were supplied or asked for. The system has its merits, like the series arc system with direct currents. It does not demand the highest grade of carbons, and the lamps are not liable to chatter at starting.

We may now consider the use of single arc lamps on the various circuit arrangements adapted to their supply. With the ordinary constant-potential, continuous-current circuits of about 110 volts, it is manifestly not desirable to operate a single lamp, taking, say, from forty to fifty volts, and waste the remainder in resistance; yet, oftentimes, it is quite undesirable that two lamps in series be connected to the mains, on account of the inability to use one or both, and one may be quite enough. The gap is filled by the "inclosed arc," and, at the same time, the necessity of frequent trimming, a disadvantage with the open arc, is obviated. The inclosed arc lamp, broadly speaking, is an outcome of the ability to secure very nearly pure carbons, or carbons containing little or no ash and particularly free from such metals as iron, the oxides of which are deep black or brown, which would soon obscure the small globe around the arc.

The inclosed arc of to-day merits more than a passing consideration, on account of the general interest which has arisen in regard to it among electric-light engineers. The idea of burning an arc in a practically closed and relatively small glass chamber is quite old.

Curiously enough, as late as about 1890, there was a revival of the inclosed arc as applied to arc light circuits in place of the ordinary series arc lamp. The sealing of the arc, so to speak, was such that about sixty-five volts were required to work it. A saving of carbons was effected, but the number of lights obtainable from an arc dynamo of any given capacity was seriously reduced, as was also the commercial value of any arc-light line whose potential was limited either by law or circumstance. Contrary to the original expectation of its promoters, the use of inclosed arcs on series circuits did not progress rapidly and soon retrograded. Many causes, besides the one of reduced capacity of lines, had undoubtedly an effect. Cheap carbons for open arcs, impure carbons for inclosed arcs, breakage of inner globes—resulting in rapid consumption of carbon—obscuration of light, etc., must have contributed largely to the result.

When it is remembered that, to get the best results with arc lamps on constant-potential circuits, the use of rather expensive cored carbons is necessary, the saving of carbon and frequent trimming becomes a very important item and permits the employment of more expensive carbons, provided they last long enough. The high voltage demanded by the inclosed arc was soon seen to be not a disadvantage, but a positive advantage for constant-potential circuits, inasmuch as it permitted the use in one lamp of a larger fraction of the total—generally 110 volts. Hence, instead of keeping down the potential, it could even be raised from sixty-five to seventy-five or to eighty volts with advantage. In fact, it may be that the exclusion of oxygen has the effect of enriching the arc flame itself, in much the same way that a slightly luminous blue flame of a Bunsen burner becomes far more luminous by cutting off the air. There may, in fact, be free condensed carbon particles in the outer

layers of the arc stream, highly heated, and therefore, strongly luminous. The flat ends of the carbons tend, also, to cause the hot gases to be retained under the positive end, thus extending the heat of the crater and increasing the luminosity. The result of the almost complete exclusion of oxygen is that very little combustion takes place and the life of the carbon is therefore much extended. The function of the small glass vessel around the arc is not only to keep out the air, but, in addition, to act as a diffuser of the light evolved, and in this sense replace, to a considerable extent, an opal outer globe of large dimensions, necessarily thick and highly absorptive. The inner globe around the arc is made thin, to withstand heat without cracking from sudden changes of temperature, and is generally of clear glass with a thin coating, either internal or external. of an opal or alabaster-like glass, which, by the materials employed in its composition, gives a large diffusive effect without undue absorption. The inner globe is often also given a yellowish color or absorptive effect for the disagreeable violet rays, of which the long-arc flame is so strong a source.

Owing to the traverse from side to side of the arc between the square ended carbons, the direction in which light is emitted from the arc most effectively is undergoing continual and very great changes so that the intensity of light in any given direction may, in a few seconds, vary several hundred per cent., and with a perfectly clear glass inclosing globe this variation would not only be quite noticeable, but in many cases intolerable. The diffusive power of the glass, however, is such, in the case of the opal coating, that the traveling of the arc is, in large measure, compensated, and the general effect is that of a very steady, uniform light. Were it not for the diffusive power the color of light, as well as the intensity, would change greatly; as when the arc happened to be on the side of the carbons away from the observer the light would then be in a greater proportion from the purple or violet arc flame, and less from the glowing ends of the carbons themselves.

The carbons to be used in an "inclosed arc" should be of the very highest grade as to purity, not too hard or dense, as straight as possible, uniform in diameter and circular in section, and should be obtained of as near a standard diameter as possible, so as to avoid the necessity for adjusting the caps of the inner globes to the size of the carbons.

The mechanism of an inclosed arc lamp to be run singly in branches from 110-volt circuits is naturally very simple. Since the lamp regulates entirely by variations of current on its circuit, a simple series magnet suffices. No cut-out other than a fuse in the lamp branch is needed.

In the use of "inclosed arcs" instead of "open arcs," one does not escape from the necessity of using in the branch with the lamp a choking resistance. A constant-potential circuit of forty-five volts will not supply current to arc lamps demanding forty-five volts at the terminals and approximately the same at the arc. By the use of resistance in circuit, however, and sufficient additional potential, the current, otherwise "unstable," becomes "stable," and the arc stable. It is possible, indeed, with especially sensitive lamp mechanism, to replace a part of the resistance needed by inductance, and thus save some energy. The "inclosed arc" also demands a sacrifice of energy in resistance, for a circuit of eighty volts constant potential will not run eighty-volt arcs.

For the purpose of discovering the minimum drop of potential required to exist over a dead resistance in circuit with arcs on constant-potential mains, the writer instituted and had tabulated a series of tests in which the resistance in circuit with arc lamps was gradually cut down along with the line voltage, while the current and voltage of the arcs were maintained the same. A set of tests was made with two Thomson '93 lamps in series, using at one time plain National carbons, and at another a cored upper of one-half inch diameter, and solid lower carbon of one-half inch diameter, Also a set of tests was carried out with eighty-volt inclosed arc lamps adjusted for currents of different amount at different times. During each test the line voltage was lowered and resistance cut out until instability of arc and current resulted, while up to that time the current and voltage of the arc were kept the same during the particular test.

The tests were sufficiently accurate to show the main point very clearly. This is that a certain line voltage as a minimum is absolutely necessary in working arc lamps on constant-potential lines, whether they be open arcs or inclosed arcs. Thus, two forty-five-volt arcs in series, with uncored carbons like the brand known as "National," cannot be safely worked below 110 volts on the line with resistance in series with them. More than 100 volts should, of course, be maintained for safety of the service.

The tests show, also, that, with a cored upper carbon, the limit is lowered several volts on the average, and it is known that the voltage of the arcs may be safely reduced somewhat when cored positives are used.

It is also shown that a seventy-five to eighty-volt arc, run upon a constant-potential line, is stable at considerably less line voltage than the open arc. It would appear, also, that, with either open or inclosed arcs at ordinary current strengths of from five to ten amperes, the steadying resistance in the branch is required to cause a drop of about fifteen to twenty volts, or waste energy at the rate in watts of fifteen to twenty multiplied by the amperes of current used in the lamp.

The running of single alternating-current arc lamps on constant-potential circuits is facilitated by the ease with which, by a transformer or compensator, the potential required for the lamp may be obtained. It was natural that, when arc lamps came to be used on constant-potential, continuous-current circuits, a demand for lamps which would work upon alternating circuits fed by transformer secondaries should arise. While in the direct-current systems the potential was definite and practically could not be adapted to the lamp, in the alternating-current case transformation was easy, as by the simple device of a compensator the line voltage could be raised or lowered to suit that demanded by the lamp. An arc-lamp compensator is simply a laminated core bearing a coil divided into sections, with connections carried out between the sections. If the self-induction of the coil is proportioned for the secondary circuit voltage in a transformer system, as for 110 volts at the ends of the coil, circuits of thirty volts may be obtained by taking three-elevenths of the turns as a secondary, that is, by connections which include between them any turns of the coil which equal three-elevenths of the total, or which give thirty volts. Moreover, several connections of the kind may be made to the same coil anywhere between its ends, provided that the wire included between the two connections for one lamp circuit is sufficient to give the requisite voltage. Further, the sections of wire thus chosen may overlap each other, and portions of the compensator coil thus appear to be doing double or treble duty. Whether the current be furnished direct from the secondary of a transformer or through compensators, the lines led to the lamps are of constant-potential character, and the lamps have to be adapted thereto.

The efficiency of the alternating arc as a source of light has been shown by Prof. A. E. Blondel, in a recent paper, to be quite variable. It depends on the length of arc used with the particular carbons employed, and on the diameter of the carbons, as with continuous current. It also depends on the form of the wave of the alternating current. It was found that, with a rectangular wave alternating current, such as may be produced by reversing a continuous current by a commutator, the light given out was as seventy-nine to fifty-nine in the case of sine wave currents. This should follow from the fact that the extinctions, as Blondel pointed out, were instantaneous in the first case, and lasted for about one-quarter of an alternation in the case of the sine wave.

The writer takes occasion to express the opinion that, with very flat-topped waves, or waves approaching closely to rectangular waves, the limit of periodicity would be found far below forty per second, as regards the maintenance of an arc. If the reversal or passage through zero is quick enough, almost any reduction of periodicity would become possible. There are, however, practical considerations which set the limits in such a case. Soft carbons, of those best suited to readily furnish considerable volatile matter, seem to be best adapted to alternating-current arcs, and they are frequently cored. The color of the light suffers some in consequence.

The use of single arcs across alternating constant-potential mains requires only that the lamp mechanism be operated by variations of the current passing the arc. Hence, an electromagnet in series is used to lift and feed the carbons, or sometimes the expansion of a high-resistance wire, traversed by the lamp current, has been applied for the same purpose, as in the "Kester" lamp. In the use of a hot wire the objection of chattering at the start is overcome without difficulty, and the wire is noiseless in its action; but it demands that considerable energy be wasted in it, and hitherto the temperature at which the wire must be run to secure sensitiveness of feed or rapid heating and cooling, following variations of cur-

rent, has been such as to endanger its permanence or cause it to oxidize. If the arc requires twenty-eight to thirty volts, and the regulating wire five to seven volts, it is easy to see that a considerable sacrifice has been made for the result attained, particularly as in the use of a hot wire overfeeding is liable to take place. The writer obtained, a considerable time ago, a much better result by using the hot-wire principle, but variably shunting it by a set of contacts controlled by a small electromagnet in series relation, which addition imparted greatly increased sensitiveness, while the slow start given by the hot wire was still secured.

The arc in the ordinary alternating-current arc lamp appears to be stable, even when the connection is made across constant-potential mains without resistance or reactance in the branch as a check upon the current. Therefore, nearly all the energy may be thus delivered to the arc itself without deduction. This fact tends to neutralize the lower efficiency of light production in the alternating arc, since the continuous-current arc on constant potentials involves a dead resistance loss. Any comparison, then, must, for practical purposes, consider the total energy used in the branch in which the lamp exists, and the light produced or emitted in directions permitting utilization.

While the alternating arc, run from constant potentials, is feasible, the difficulty of chattering and large variations of current at starting results from the arrangement, and any sudden fall of potential may cause a momentary extinguishment. Particularly is this the case when the arc is of the "inclosed," long-burning type. In such case, on account of the greater length of the arc, it is peculiarly sensitive to influences which would affect but slightly the ordinary open-air arc.

It is too early to predict what part the "inclosed" alternating arc may play in the future art of arc lighting, but it probably will find a considerable application.

When an alternating arc is run with a considerable dead resistance in series with it, or when a reactance coil is in series, or when it is fed from the secondary of a leakage transformer, taking the whole current thereof, the condition approaches, though in cases only imperfectly, the running of the lamp on approximately constant current. In reality, the condition is intermediate between constant-current and constant-potential working. In such a case the regulation of the lamp may be by a series magnet, or a shunt magnet, or by a combination of both. In fact, there is no real utility in generating a constant current of alternating character for working a single lamp. The utility of the "intermediate" working, just alluded to, is in the lessened liability to rupture of arc, lessened chattering at starting, and avoidance of excessive flux of current if the carbons by accident come together. The condition is one decidedly useful in the case of the "inclosed arc" of alternating type, and it is doubtful if such arcs can be run except under conditions like those here called "intermediate." For saving energy a reactance or reactive coil in the lamp circuit is preferable to a dead resistance, and is relatively more effective.

It may be well to add to the present paper, which has grown to unexpected length, a statement concerning the results arrived at by innumerable tests of the different types of arcs and arc lamps under conditions resembling those of practice, with a view of ascertaining their lighting values. These tests have been embodied in comprehensive reports by Mr. Jesse Coates, of the testing department of the General Electric Company, at Lynn, and the tabulated results might easily furnish material for a lengthy discussion. They embody complete series of measurements of candle-power in various directions, and curves of the same for each kind of arc or condition of surrounding globe, together with mean spherical and estimated useful illuminating intensities, The methods of measurement cannot be detailed here, but are such as in the writer's judgment can be relied upon to give comparative figures. Moreover, the mean of many observations is in each case taken for comparison and plotting of curves.

The purpose here shall be to state in a general way some of the results obtained.

It is well known that the larger the arc, or the larger the current in it with a normal voltage, the more efficient is the light production. The energy is more effectively converted into luminous waves, so that the watts per candle would naturally be less with a twenty-ampere arc at forty-eight volts than with ten amperes flowing. Measurement shows that where, with continuous current, the same brand of hard carbons is used of diameters varying approximately with the current strength, naked arcs, with ten amperes and forty-eight volts, may take for each mean spherical candle-power 1.2 watts, while arcs of seven amperes and forty-eight volts require 1.4 watts.

The use of a cored upper carbon appears to raise the efficiency to a moderate extent, probably because the arc may be maintained at a voltage somewhat less, as at forty-two or forty-four volts. The use of a clear globe surrounding the arc loses 10 to 12 per cent. of the light, while alabaster and opal globes lose from 45 to 65, according to their thickness and the specific absorptive power of the glass. Naturally, since an enclosed arc, consuming approximately the same energy in watts at the arc as a ten-ampere open arc, will have a current of only about seven and one-half amperes, the efficiency would be expected to be less. Measurements show, after a run of 102 hours, and per each mean spherical candle-power of a four and three-quarter-ampere, inclosed, continuous-current arc with clear inner and no outer globe (one-half-inch carbons), an expenditure of 1.94 watts at the arc. If the energy expended in the lamp branch be taken as the true expenditure, that lost in resistance is added to that of the arc, and the watts per candle increased accordingly. A similar loss is, of course, experienced with naked or open arcs on constant potentials, owing to resistance being used in series. The result given above, or 1.94 watts per candle, is at the end of a long run of 102 hours, but with a clear inner globe. Inclosed arc lamps with clear inner and clear outer globes are not satisfactory, and in fact, for good results of uniformity and diffusion, a slightly opal inner globe is needed. Those now known as "alabaster" are well suited to the purpose. When these are used, the watts at the arc per mean spherical candle-power will at the first part of a run range about two watts, increasing seriously only toward the very end of the run. While it may seem that the watts per candle are higher than might be expected, yet it must be borne in mind that in all inclosed arcs the current is relatively small and the potential high for a given expenditure of energy, and this acts in a double way to lower the efficiency, as not only the crater emitting light is smaller, but a large part of the energy goes to sustain the arc flame, which is long, while also, the absorption of light by the surrounding glass is not to be neglected. No construction of lamp, regulation or adjustment thereof can get rid of the inherent properties here pointed out. Nevertheless, it is true that the character of the light, both of the open or exposed arc, and of the inclosed arc, is such as to make it very desirable as a substitute for daylight and for many cases of use. The fact that the light is shed mainly downward by continuous-current arcs results virtually in an addition to the efficiency and economy of the light; thus, if the light emitted downward be considered as alone useful, the expenditure per mean useful candle would, with naked arcs, fall to about one-half a watt, and with inclosed arcs, to from one to one and one-half watts at the arc.

With alternating arcs the conditions are different, since the light is sent up and down equally. By a reflector placed above the arc, a considerable fraction of the light which would often be lost upward is sent downward to increase the effectiveness; thus, a sixteen-ampere, twenty-five-volt, naked alternating-current arc used per mean spherical candle, 1.49 watts, or for mean useful below the horizontal, 1.12 watts, which was reduced to .8 to .9 watt when a porcelain reflector above the arc was used. For the same causes that necessarily reduce the efficiency of an inclosed continuous-current arc as compared with the uninclosed, the efficiency of an inclosed alternating arc falls below that of the open arc with similar currents. The watts at arc per candle will be found, per mean spherical candle, to be under the best conditions about two watts, increasing toward the end of the run, owing to obscuration of the inner globe and other causes. No reflector or deflector can be used with much effect with the inclosed arc, so that the mean useful is but little different from the mean spherical candle-power.

The apparent advantage in economy of the continuous-current inclosed arc over that with alternating currents is in large measure neutralized by the fact of the former requiring a dead resistance in circuit to give stability to the current, while the latter can be run without it, or, at most, with a reactive coil which wastes but little energy.

It should be said, in conclusion, that the figures given above and expressing the watts per mean spherical candle, while strictly comparative so far as a study of arc lights alone is concerned, might vary somewhat if the object had been to compare arc and incandescent lights, owing to the difference in color of lght, though the variation would not in any case be great.

Electric Lighting Subways.—II.

METHODS OF THEIR CONSTRUCTION, ETC.

BY WILLIAM MAVER, JR.

When the cost of constructing an underground conduit system and the inconvenience as well as the cost of making repairs are considered, it is clear that one of the main points to be looked into is how best to bring about a permanent system. This involves the matter of durability of the ducts, which may be affected by breakage or by corrosion. So far as breakage due to heavy traffic is concerned it is admitted that the advantage is with the wrought-iron pipes, but experience shows that, assuming the ducts in each case to be laid directly in the earth, the terra-cotta ducts will, generally speaking, outlast the iron pipes. But inasmuch as it is now the common practice to lay all ducts alike, in a bed of concrete, and not in the earth direct, strength is imparted to the terra-cotta ducts and the rusting of the iron pipes is prevented. In this relation it may be stated that several specimens of iron pipe which have been thus embedded in concrete in the New York subways for ten years were recently examined and found to be free from rust or corrosion of any kind on the outside, and but a slight discoloration was noticeable on the inside of the pipes.

There is also to be considered the effect, if any, that may be produced upon the cables by contact with the material composing the ducts. It was, for instance, at one time suggested that corrosion due to a galvanic action between the lead casing of the cables and the iron of the ducts would ultimately destroy the cables. But for two reasons this suggestion may be neglected; first, because in the event of any galvanic action being set up, it would

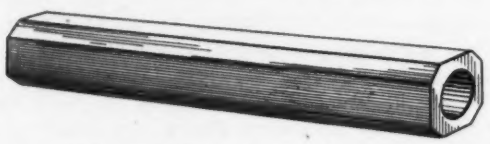


Fig. 3.—Terra-Cotta Conduit.

doubtless be the iron which would suffer; secondly, years of experience have shown that no perceptible effect from the proximity of the two metals has resulted. Again, there is the alleged action upon the cables that may be due to setting free the radicals in the salts used in the glazing of earthenware ducts, an action which is said to have had an injurious action upon conductors in earthenware conduits in Paris. In this country, however, so far as the writer has been able to ascertain, there has not been any detrimental effect upon the cables due to this cause.

The use of improperly creosoted wooden ducts has also been found in the past to injuriously affect the lead covers of the cables placed therein, but the employment of dead oil of wood tar as a preservative of the wood has seemingly obviated any further action of the nature just mentioned.

The employment of iron ducts for the conduits in which alternating circuits, and, perhaps more especially multiphase ciucuits, are to be placed, is also to be considered from the electrical standpoint, but it may be said that where the conductors are placed in the same ducts the results thus far have not shown any noticeable losses of electrical energy. On this point it may be stated that there is in operation in the New York iron pipe ducts one circuit having over twenty-seven miles of conductors.

The writer has been unable to obtain any definite information as to whether there is any difference in the amount of electrolysis that takes place on the cables in terra-cotta or other forms of nominally insulating conduits, as compared with that which occurs in iron ducts, due to the return current from neighboring electric traction conductors. The facility with which the iron ducts could be grounded would seem to indicate that electrolytic action might be less in the iron pipe than in insulated conduits, so far as the cables therein are concerned, the return current naturally following the bunched iron pipes in preference to the lead of the cables. Although the iron pipes are laid in concrete, a semi-insulator, the writer has not yet found an instance in which the iron pipes of subways did not furnish an excellent "ground."

Another point is that of the possibility of explosions due to sparks occasioned by the jumping of the induced currents from the lead covering of alternating current conductors. The writer has seen it stated that sparks from this cause have been observed in electric subways. It would be interesting to know whether this is of frequent occurrence, and whether it takes place in all types of subways. The writer, whose experience has been mainly with iron-pipe conduits, has never observed this action, and has attributed the absence thereof to the presence of the iron pipes, which dissipate the induced currents generated on the lead casing so uniformly along their length that the sparking referred to is obviated. It is, of course, known that sparking occurs on lead-

Fig. 4.—Cement-Lined Iron Pipe Conduit.

encased cables, conveying alternating currents when carried on insulators, and shocks from the induced currents are frequently received by those handling these cables. The latter, it may be said, is not the case when the cables are laid in iron ducts.

Another feature to be considered also in the selection of the material for the conduits is the facility with which cables may be drawn into and out of ducts without injury. Thus, absence of sharp edges at joints and elsewhere, and burrs, must be guarded against. The use of any substance which should tend to soften and imbed the cables so that they could not be withdrawn should also be avoided. In some of the first iron pipe conduits that were laid in this country a heavy coating of tar or asphaltum was

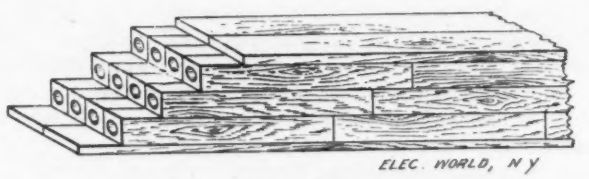
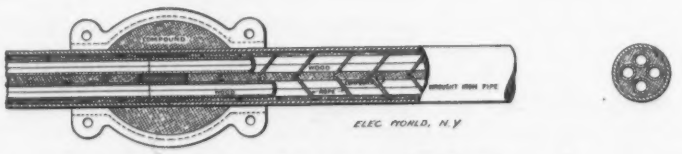


Fig. 5.—Pump Log Conduit.

used as a preservative, with the result that it became a difficult matter to withdraw cables when desired. It has been assumed that in the absence of some preservative of this nature the iron would rust and scale off, thereby clogging up the ducts, but this assumption is not warranted by the facts, and the use of close-fitting smooth joints in wrought-iron pipes avoids injury to the cables in hauling in or out. Precautions are also taken to remove sharp edges, burrs, etc., from cement-lined and terra-cotta ducts. It may be added that the wrought iron pipes are now merely dipped in a solution of some preserving material which hardens, after the manner of paint or varnish, and does not soften at the ordinary temperatures met with in the subways.

In the work of subway construction the width and depth of the trench will vary with the number of ducts to be laid in the conduit.



Figs. 6 and 7.—Cummings Conduit.

As already intimated, the practice which has prevailed of recent years, in this country at least, in electrical subway construction of the drawing in and out type, is to lay the ducts in a bed of hydraulic cement concrete, well rammed, the trench having previously been levelled to grade; the walls being sustained by planks. Over the first row of pipes or ducts another layer of concrete is laid, then another row of pipes, and so on, as indicated in Fig. 2, which represents an iron-pipe conduit in the course of construction in New York City. The concrete is applied more thickly to the bottom, top and sides of the conduit than between the pipes,

to add strength to the mass and to protect the pipes from mechanical injury due to the strain of street traffic, etc.

In the case of hollow brick or terra-cotta ducts, large quantities of which are now being used, especially for telephone conduits, the amount of concrete used in the trench varies somewhat with the number of ducts in the conduit, in order to secure necessary mechanical strength to the conduit, and in those instances where but one or two ducts are necessary it may become a question sometimes whether the additional concrete required to bring about this strength may not offset the difference in price between between vitrified clay and iron pipes.

In laying hollow brick ducts the ends of the ducts are butted together—the ends being cut square and without sockets—and the joints are cemented; a close-fitting mandrel being pushed through the pipes to insure perfect alignment and to remove any cement which may have entered the duct. The length of these ducts is usually eighteen inches, and they vary in diameter from two to three inches. In laying up these ducts, the joints are broken with joints of adjoining rows. Upon each layer of ducts a semi-liquid mortar is poured, filling the spaces between the ducts and covering them to a depth of about one quarter of an inch. One of these ducts is outlined in Fig. 3. A form of terra-cotta block or multiple duct is also used. This is made in lengths of four to six feet, and with as many ducts as may be desired. This type of conduit is also laid up in concrete cement. It possesses the advantage of minimum space underground, but probably is not so flexible as single-pipe ducts for general conduit work in cities, where frequently ducts have to be separated to avoid other pipes and obstructions.

The length of wrought-iron pipe as generally used for conduits is twenty feet, and their diameter is from two feet five inches to four inches. The pipes are joined together by a screw coupling with a vanishing thread. Cement-lined iron pipes are usually made in single tubes, from seven to eight feet in length, and of any desired diameter. The tubes consist of sheet wrought iron, well riveted (see Fig. 4), and lined with five-eighths of an inch of pure Rosendale cement, no sand being used. Socket joints are used, and are so designed that a smooth inner surface is secured at the joints when the pipes are laid end to end.

Wood pipe or pump log conduits are usually about eight feet in length, and have male and female socket joints, about three inches in length. These ducts are laid in the trench in rows, as outlined in Fig. 5, the lowest tier being laid on planking; the uppermost tier is also covered with similar planking—the joints being broken as shown in the figure.

It is understood that the foregoing-described types of drawing in conduits are designed to serve as a receptacle and mechanical protection only for well-insulated cables or conductors, it being generally admitted that for omnibus or jointly occupied conduits this is the most practicable method.

As an instance of the bare wire drawing in conduit, in which the insulation is provided by the conduit itself, the Cummings conduit which is in somewhat limited use in this country for low-pressure service, may be briefly described. The ducts for this purpose are made in twenty-feet lengths from thoroughly dried wood, after which they are boiled in oils, which saturate the wood. The ducts are then wound externally with a rope which has also been saturated with the same oils. The desired number of ducts are then grouped and tied together by an outside binding, after which they are placed in a lap-welded iron pipe, also twenty feet in length, the pipe having previously been dipped in an insulating varnish. Socket joints are provided, and a turtle-shaped cast-iron box is securely bolted to the type over the joint. The box is then filled with the insulating compound. A cross-section of this conduit is shown in Fig. 6; the coupling and box are shown in Fig. 7. Each duct is designed to hold but one bare wire, and the bore may therefore range from half an inch to two inches or more. The wires are drawn in after the conduit is laid.

Depending upon whether any of the foregoing conduits are designed for trunk lines or for house-to-house service, the depth of the trench will vary. In some cases, as notably in New York City, the trunk ducts and distributing ducts are combined in the one trench; the distributing ducts being placed above the trunk ducts and as near to the surface as practicable.

Independent Telephone Convention.

At the recent gathering of representatives of independent telephone exchanges in Chicago a committee was appointed to issue a call for a meeting of those interested in independent telephony. This call has just been issued in this form:

"In pursuance of a call issued for that purpose, there assembled in Chicago on the 27th and 28th ultimo, about 300 gentlemen interested in independent telephone exchanges, representing more than fifteen States. At this meeting, the matter of the organization of a national association of the persons and companies operating independent telephone exchanges and toll lines, together with all companies and persons interested as manufacturers of telephonic apparatus, was thoroughly discussed and considered. After mature deliberation, an executive committee consisting of two gentlemen from each State represented was appointed by the chairman of the convention, and by resolution then unanimously adopted this committee was clothed with power and directed to take all the steps necessary to complete organization of independent telephone interests, and were specifically directed to prepare and issue a call for a meeting of representatives of independent interests to convene in Detroit, Mich., at 12 o'clock noon, on Tuesday, June 22, 1897, and to continue in session until the purpose for which it was called had been accomplished. At this meeting each company, partnership, or person owning or operating an independent telephone exchange or toll line, or interested in the manufacture or sale of such apparatus in the United States, is earnestly urged to have at least one representative clothed with authority to bind his principals, and act for them or him in any matters which may be considered by this convention touching the independent telephone situation. There are numerous things which will come up for consideration at that time, which will be of vital interest to you.

"The time has now arrived when all persons interested in independent telephony, whether as users or manufacturers, should form a union for mutual advantage and strength. When such an association has been formed, the extent of the independent movement, the number of independent exchanges, the rapidity of its growth, and the satisfactory service rendered by such apparatus, together with the large number of persons directly interested throughout the United States will form such an association as can promptly and successfully extend the benefits of independent telephone service to every corner of the United States, and resist any encroachments upon the rights of its members. A like notice has this day been sent to each known manufacturer of independent telephones and telephonic apparatus in the United States.

"The interest manifested in the Chicago meeting leads us to believe that the meeting at Detroit will be a most successful and satisfactory one, and no one interested in independent telephone business can afford to be absent from or unrepresented at this meeting. Please acknowledge receipt, stating whether or not you will have a representative present. Address W. J. Vesey, secretary, Fort Wayne, Ind.

"By order of the Committee.

"J. M. THOMAS, *President*,
"W. J. VESEY, *Secretary*."

The Electrostatic Discharge from a Crookes Tube.

To the Editor of The Electrical World:

Sir—In an article in a recent number of your journal on "An Action of Fluorescent Substances on the Cathode and X Rays," the author states: "If the vacuum of the tube has become just so 'high' that the discharge ceases to pass in the tube, the discharge in the tube will be re-established by bringing the hand very close to or in contact with the tube." I think I can throw some light on the cause of the above action. In an article in THE ELECTRICAL WORLD of July 20, 1895, I described some experiments with the electrostatic discharge coming from a coil of wire attached to an induction coil. Among others made with the coil and not there described were the following:

I placed an isolated sensitive lamp bulb or Geissler tube on a wooden stand in front of the coil of wire, and found when the bulb was something like a foot from the coil of wire it was still lighted up without being connected to any large conducting body or grounded, but when moved further away from the coil, the light in the bulb disappeared. If standing back of the bulb, how-

ever, I advanced my hand towards it, light would begin to flash in the bulb, and when my hand was very near it the bulb would be lighted up very brightly; but if I advanced the other hand or turned my body to the side of the bulb it would lose its light, although a large book intervened. A sensitive lamp bulb when held anywhere in the neighborhood of a Crookes tube when it is excited will light up from the electrostatic discharge coming from the tube. I think it likely that the electrostatic discharge re-establishes the discharge through the Crookes tube. The person holding a hand in front of the tube become charged from proximity to parts of the arrangement that are excited, and by means of induction from his hand into the Crookes tube starts a discharge between the electrodes of the tube. Another experiment described in the article mentioned appears to fit the action more exactly. When a wire was connected to a Geissler tube and the other end of the wire was brought near the coil of wire mentioned above, and a finger was advanced to the free end of the wire, the tube lighted up, although the finger did not quite touch the wire. This was evidently induction from the person standing close to the excited coil to the wire connected with the bulb. A. G. Dell.

Baltimore, Md.

Impulse Water Wheel Experiments.

To the Editor of The Electrical World:

In your issue of June 5, Mr. E. A. Hitchcock reports on some efficiency tests of a water-wheel made by Messrs. Donham, Frayer and Cilly, in the hydraulic laboratory of the Ohio State University, which the manufacturers stated to be made under the Bookwalter patents of February 9, 1891, but which in its essential parts, namely, the vanes, shows absolutely no similarity with what these patents describe, but does show the configuration of vanes, as patented to me on March 16, 1897, as the result of my application of June 2, 1893.

In relation to the tests it is stated that: "Calibrations of the nozzles used indicated the amount of water discharged."

This, in plain English, states that the water ejected during the test was neither directly weighed nor directly measured.

As a result of my publications in matters of hydraulics for some years past, competent hydraulicians do not longer contest the fact that to measure efficiencies of water-wheels two conditions must be exclusively relied upon, namely (1), the aperture of ejection, and (2) the quantity of water ejected.

To assume that the one be indicated by the other is equivalent to a fundamental falsification, though unintentional, of the conditions of the test.

It is to this falsification that the excessive, improbable, impossible results of the tests (92.36 per cent. of efficiency) must be ascribed.

Velocities cannot be practically measured except by the quotient $Qy \div F$ (compare the pamphlet of the American Impulse Wheel Company, of New York, pp. 35-37). Mr. Hitchcock states for his preferred test, No. 3, a greater velocity than the one indicated by this quotient, $2085 \div (60 \times 0.34045) = 102.061$, thereby directly proving the existence of discrepancies between his own figures, the greatest discrepancy being, in all probability, the understating of the quantity of water ejected, which was neither weighed nor measured, but calculated on an erroneous assumption, as shown.

New York. F. M. F. Cazin.

The Inventor and the Technical Journal.

To the Editor of The Electrical World:

Sir—If it were proper to pick one statement out of a lengthy article, and to apply this statement to readers for whom the whole article was not intended, then the remarks of Mr. Albert Gould Davis in your issue of May 29 would be quite in order. His reference to valuable detail patents would also be good if those which he mentions were not taken out by men familiar with the electrical work; yes, doubly so, from their steady contact with technical papers devoted to this line. Most readers of my article will see that it was addressed to that quite different class of inventors who are not so well informed as to the electrical needs of to-day or to-morrow.

As Mr. Davis himself says: "If a device is new, useful and patentable, and if it have a commercial value at any time within the seventeen years of its life, it is worth patenting." The corollary to this would be that a device which is not so distinctively new and needed as to promise a commercial value is not worthy of a patent. It may still stand one chance in a hundred or a thousand of growing valuable within seventeen years, but to bank on this means a mere speculation, and there is altogether too much of this speculating already. The tendency toward it is so strong that we can see all around us how it interferes with the deliberate concentration of time, energy and expense on fewer but really promising patents. If Mr. Davis has not noticed any of this speculative "throwing away" of patent fees, his acquaintance with patentees must be quite different from my own, for mine is showing me that the daily papers and "inventor's journals" of to-day are leading to an unwarranted amount of "rushing into the Patent Office." The cold facts in the case may seem strong (and of course there will be exceptions), but I think there is no danger of stating the situation too forcibly to counteract those influences which are to-day misleading so many inventive minds. Happily the general tone of our electrical papers of to-day is a healthy one in this as in other respects, and I believe it quite important that we should encourage the more widespread reading of these fine journals. Albert Scheible.

The World's Aluminum Output.

In a communication to the State Department, under date of April 7, 1897, United States Consul Germain, at Zurich, Switzerland, gives some interesting statistics regarding the production of aluminum in the different countries, together with the horse-power employed and the daily capacity of each plant. These facts are embodied in the following table:

Works.	Horse Power	Average Daily Production.	
United States.			
Pittsburg Reduction Company's works:		*Kilograms.*	*Pounds.*
At Kensington, Pa.	1,600	906	1,993
At Niagara Falls, N. Y.	1,600	1,000	2,200
Switzerland.			
Aluminium Ind. Gesellschaft, Neuhausen	4,000	2,270	4,994
France.			
Société Elec. Mét. Franc. at Lapraz	2,500	1,370	2,992
Sociéte Ind. de l'Aluminum at St. Michel	2,000	1,134	2,495
Total	11,700	6,670	14,674

Or, in round numbers, 6700 kilograms (14,740 pounds), giving at present an annual production of about 2000 metric tons. The output during 1895 was about 1200 metric tons. A considerable reduction in the price of aluminum, on account of the additions to works now in operation and their increase in horse-power capacity, as well as the contemplated erection of new plants, is imminent. In Great Britain, the British Aluminum Company has purchased the Irish bauxite pits, for the purpose of manufacturing aluminum at Larne Harbor, near Belfast. The same company has bought water rights at Foyers Falls, in Scotland, where 4000 horse-power is at its disposition.

The new addition to the Neuhausen works, which is to be operated by the Heroult system, will, when in operation, add 2700 kilograms (5940 pounds) to its daily production. A German-American syndicate has planned the erection of works for the manufacture of aluminum at the waterfalls of Sarpfoss, in Norway. The water-power there, it is estimated, will produce 10,000 horse-power, and the plant is to be ready for operation some time in 1898. If they utilize 5000 horse-power, a daily production of 3000 kilograms will result. Further, the Neuhausen Company is building new works with water-power to produce 10,000 horse-power, at Rheinfelden, Switzerland, and has also acquired water rights for similar purposes at Lend, near Gastein, in Austria.

These new additions (Rheinfelden, 6000 horse-power; Foyers Falls, 3000 horse-power; Sarpfoss Falls, 5000 horse-power), as well as the increased horse-power capacities projected for the plants now in existence (the increase of 7100 horse-power at Niagara Falls and 4000 horse-power at St. Michel), will, in the year 1898, with an aggregate capacity of 33,000 horse-power, turn out an average of 19,300 kilograms (42,460 pounds) daily, or, annually, 5790 metric tons. It becomes therefore evident that the price of aluminum will fall to about 3 francs (60 cents) per kilogram, or about 27 cents per pound, so that soon but three commercial metals will be cheaper than aluminum, namely, iron, lead, and zinc.

Proceedings of the Twentieth Convention, NATIONAL ELECTRIC LIGHT ASSOCIATION Niagara Falls, N.Y. June 8, 9 & 10, 1897.

The twentieth convention of the National Electric Light Association, which has just closed its session at Niagara Falls, will long be remembered as one of the most interesting and successful meetings in the history of that body. The attendance was unusually large, and the generally expressed opinion was that at no previous convention had there ever been quite the enthusiastic interest elicited by this gathering.

Niagara Falls has come to be regarded by electrical men of every sort with an interest wholly apart from its great beauty and picturesqueness. It is now known by the sobriquet "Electric City," and seems to have justly earned the title, for nowhere else in the world are there such magnificent developments of electricity or such perfect conditions for the successful transmission and utilization in many ways of electrical energy.

A meeting of the National Electric Light Association is always a most interesting occasion. Its members are representative of the best class of American men of business and of science. Pre-eminently practical, they are struggling under conditions as diverse as the regions from which they come, and with success which is not only satisfying but remarkable as well.

The custom of the annual interchange of experiences on the part of these busy workers has come to be a fixed one, is looked forward to with the greatest pleasure and interest by those who take part in the conventions, and is always productive of much good to those who attend.

The meeting just closed was particularly satisfying in these repects, not only on account of the high quality of the papers presented, the interest of the topics discussed, and the instructive discussion which followed the papers, but also for the opportunities presented at Niagara for the inspection and study of the great electrical developments at that place.

The reports of the committees this year were of more than usual importance, as they dealt with topics of the liveliest interest to practical electric light men. The display of exhibits was smaller than usual, but the attendance of manufacturers and their representatives was large, and, as is usual at such conventions, a considerable amount of business was transacted between these urbane and enterprising gentlemen and the station managers present.

First Day, Tuesday, June 8.

MORNING SESSION.

The meeting was called to order at 11 o'clock by President Nicholls, who occupied the chair. A large number of invitations from the electrical manufacturing concerns and power plants in and near Niagara Falls were read, the companies in each case extending the freedom of their works to the members and their guests. The American Telephone & Telegraph Company extended to the members the free use of the long-distance telephone during certain specified hours.

After the reading of letters of regret from Prof. Nichols, Sir William Dawson, Prof. H. T. Bovie, who could not be present at the meeting, and a letter from Lord Kelvin, in acknowledgment of the address sent him by the association on the occasion of the fiftieth anniversary of his professorship, President Nicholls delivered his address.

Mr. Nicholls stated the reasons for the selection of Niagara Falls as the place of meeting on account of its pre-eminence as an electrical-power distribution centre. Referring to the status of the association, financially and otherwise, he said that it had never before enjoyed such prestige or such an excellent financial condition.

At this meeting, although offers of entertainments and privileges had been numerous, only those from electrical concerns had been accepted, it being felt that this was more purely a business meeting, held for the furtherance of the immediate objects of the association. He referred to the interim reports for a full account of his stewardship.

In conclusion, President Nicholls said that the association and the electrical profession owed a deep debt of gratitude to the electrical press, and that the importance of its labors in behalf of electrical industries could hardly be over-estimated.

The address was quite short, and was received with much appreciation by those present.

The reports of committees were then received. The Committee on Standard Candle Power of Incandescent Lamps was deferred until a later meeting, at the request of the former president, Mr. James I. Ayer.

The Committee on Data made its report through Mr. H. M. Swetland, its chairman. The labors of this committee have consisted in obtaining data regarding the cost of production of electricity under various methods. The report, which embodies the results obtained by an engineering expert engaged for this purpose, covers only fourteen plants. The majority of station managers object to the publication of their data, hence the restricted ground of the report. A vote of thanks was tendered to Mr. Swetland for his untiring devotion to the duties of his committee, and, at his request, the committee was discharged.

The report of the Finance Committee submitted by Chairman John A. Seely was highly gratifying. It showed that the association possessed net assets of $52,572.23, of which $1,385.94 consisted of cash, and not a cent of indebtedness.

AFTERNOON SESSION.

The meeting was called to order at 2 o'clock. A letter from the Erie Gas Engine Company, inviting the appointment of a committee to inspect and test its engine, was read.

The president stated that a number of invitations had been received from various cities for the holding of the next convention. Prof. R. B. Owens, of Omaha, Neb., spoke in behalf of his city, and Mr. Woolen, representing the Commercial Club, of Indianapolis, Ind., strongly urged the selection of that city as the next meeting place. The invitations were referred to the Executive Committee for action.

Mr. J. B. Cahoon, of Elmira, N. Y., read a paper entitled "The Establishment of a Base Price for Current." It dealt particularly with the lack of knowledge of the cost of incandescent lights and the difference between charges for these lights and arcs. There are many elements of cost in the production of current which do not vary much from place to place, and some that do, so that the basis of charge should be manifestly upon the variable factor, viz., coal. Assuming bituminous coal with an evaporative power of 12 pounds, at $2 per ton, the cost of the coal would be about 25 per cent. of the total expense for current generation. Curves can be plotted, showing the relation of the cost of coal to the total. These are parabolas passing through the origin, when cost of coal and its percentage of the total are taken along the axes of reference. These curves admit the rapid calculation of the proper changes in any given case. The paper also contained a number of examples of blank forms in use in central stations for the accounting of the various expenses.

Mr. Bache said that the discussion of the matter of blanks would be better deferred. He spoke of the desirability of a uniform system of such blanks, so that similar stations might compare their data. Much published data is practically worthless, by reason of not being applicable to stations of other classes than those from which they are compiled. This caused much dissatisfaction among small stations who tried to emulate the records of larger ones. Mr. Bache spoke of his fourteen years' experience, and gave some

figures of small-station operation in comparison with those from the larger plants.

At the close of the discussion the convention passed a vote of thanks to Mr. Cahoon for his valuable paper.

The discussion of the topic "Theft of Current and How to Deal With It," resulted in an interesting exchange of experiences. President Nicholls in introducing the topic regretted the general absence of laws covering the subject. Mr. T. C. Martin, at the invitation of the president, spoke of the bill passed by the Connecticut Legislature, penalizing theft of current. This provides a small money fine and a very short term of imprisonment. The bill seemed defective in its requirements of proof of theft. In Louisville, Ky., recently in a case of theft, counsel had moved to dismiss the charge on the ground that it was not a statutory offense to steal current, but the judge had held the prisoner for trial.

Mr. James I. Ayer suggested that it was time for action on the part of the association in this matter, and that a committee be appointed to draft a statute which might be supplied to the members through the secretary upon its completion. The object of this would be to have bills drafted by those best fitted to understand the subject, and to have a practical uniformity in the bills brought before the various Legislatures to secure laws such that precedents in one State would hold in another.

Mr. A. M. Young, who, as treasurer of the Connecticut Electric Light Association, drafted the bill now in force in that State, gave some account of it. The fine for theft is $30, and the imprisonment period thirty days, and both may be inflicted if the trial judge so decides.

Mr. George R. Stetson spoke of the Massachusetts law. In one case of theft of about half a dollar's worth of current, it cost the offender $55. The lawyer who defended the prisoner in this case was the same man who drafted the present bill. The moral effect of the law, Mr. Stetson thinks, is excellent.

Mr. Barker made a few remarks concerning the Massachusetts law. The courts had held the stealing of gas as a common law offense, and the same in the case of electricity. The act is similar to those referring to the theft of gas and water.

Mr. John I. Beggs said he had been instrumental in some convictions in Cincinnati. There was no definite law, but he had had clear cases and easily secured conviction. The greatest difficulty lies in the tampering with measuring instruments. The proposed draft to be made by the committee should include penalties for this. He related some amusing instances of theft of current and the difficulties in the way of securing convictions.

After some further discussion, Judge E. A. Armstrong said that in the few existing laws the penalty was grossly inadequate. If the Grand Jury should bring an indictment for theft of current before his court, he would not hesitate to sentence the prisoner for larceny. The Connecticut and Michigan laws, however, make this offense a small misdemeanor. The great difficulty in framing an act would be to take cognizance of those courts which had held that no property right could exist in an intangible and undefinable agent like electricity, and that as it had no material existence, it could not belong to anybody, and, hence, could not be stolen. Courts and Legislatures are ignorant of the method of producing electricity, and might be greatly enlightened by an object lesson. The act should make fraud against electric light companies an offense, not specifically theft of current. The association should never officially recognize the views of those who hold that no property right could exist in electricity.

At the close of the discussion a motion to appoint a committee of three to make a draft of a proper act was carried.

Capt. William Brophy, chairman of the Committee on Safe Wiring, presented the report of his committee regarding the formulation of a national code of electrical rules covering electrical construction, fitting and installation. In reading the report, Captain Brophy reviewed from the beginning the gradually increasing and diversified requirements covering the installation of electrical apparatus. The National Electric Light Association, desirous of bringing forth a uniform code governing such work, has now been laboring, through its committee, for many years in the attempt to unite all interests—those who insure, those who are insured, and those who do the work—in the adoption of a common standard code. The first committee formulated and revised the code which is in use to-day by most inspection bureaus, and has, with modifications, been generally, although not entirely, accepted as a standard. Referring to the recent national conference to modify and change the rules so that they would be acceptable to all interests, he said the committee appointed at this conference had evolved a perfected code, which was presented to the association for its acceptance. After some discussion, the amended rules were, on motion, accepted.

WEDNESDAY, JUNE 9.

MORNING SESSION.

The meeting was called to order at 10:30 o'clock by the president, who announced that Mr. C. L. Edgar, who was on the programme to read a paper entitled "Correct Method of Charging for Product" was not present, and that as no copy of his paper had been received Mr. J. G. White, the next in order, would read his paper upon "The Niagara Power Transmission Line."

Mr. White's paper included an interesting review of the history and an account of the construction of the line, and the reasons adopted for the various specific modifications in the usual design of power transmission lines adopted in this instance. It was of a practical nature, and was listened to with the deepest interest on the part of all present. At its conclusion Mr. White, in reply to a question by Mr. Seely, explained that it was perfectly practicable to replace insulators on the line without shutting off the current. This has been done by the use of a large insulated stool, on which a ladder is placed, or by handling the wire with an insulator mounted on the top of a pole, which is forced up under it, thus lifting it off of the pin insulator and permitting the ladder to be replaced. With current of 10,000 volts the capacity of a man is sufficient to cause a flow of current which will give him a considerable shock, and a nervous man might be knocked off the ladder by this. The consequence is that replacing insulators is neither a very safe nor a very pleasant task.

In reply to a question by Mr. W. Worth Bean, Mr. White said that under all circumstances in lines of this character trees should be cut down on both sides of the line far enough back to make it absolutely sure that limbs could not fall upon it. This, of course, involves the acquisition of a right of way of considerable width.

In reply to other questions, Mr. White said that cross-arms had been burned off by leakage currents which went through insulators that had stood the 20,000-volt test.

The lightning arrester problem is still in process of solution, and is largely in the experimental stage. The line is protected by barbed-fence wires, which are run on top of the poles and on the outer end of the cross-arms, in a little fork at the top of an iron pin stuck through the end of the arm. At every fifth pole these fence wires are grounded with a number six copper wire running to a coil at the bottom of the pole.

Considerable discussion followed as to the relative merits of power transmission lines of this character when installed overhead or underground. Mr. White said that on the line there had been more trouble from the 4000 feet of cable than from the twenty-four miles of overhead line.

Mr. S. D. Greene said that he considered the question of lightning as the most serious point to be considered. That no test which could be applied by any manufacturing company would be sufficient to indicate the results on the line, and that only experience could guide in these matters. Replying to a question, Mr. White said that it would cost $60 per horse-power to transmit 20,000 horse-power to Buffalo on an underground line, and that it could be done for one-third of that amount with an overhead line. Under the former circumstances interest and depreciation would be at least $6 per horse-power.

Mr. Samuel Insull said that this would be a very important proportion of the selling rate of $20 per horse-power. Referring to lightning arresters, he asked Mr. Greene if it were not possible to furnish operative lightning arresters for lines up to about 1000 horse-power. Mr. Greene, replying, said that no company could guarantee a device as an absolute protection against lightning. As the amount of power delivered increases, it seems that the sale in Buffalo depends more and more largely upon the absolute reliability of the service. He did not think that the lightning protection, as described by Mr. White, was absolute by any means.

Mr. Insull said that he had been struck with the awful responsibility that rested upon those operating such enormous potentials above ground, but that the figures just given seemed to indicate that underground transmission was prohibitive, when high-class steam engines and installation of 20,000 horse-power could be made

for $100 per horse-power. If the transmission line costs $60 per horse-power, it would seem to show that long-distance transmission, even at this distance of only twenty-seven miles, by underground-conducting systems would be prohibitive.

Mr. John I. Beggs said that he had seriously questioned the great advantage to be derived at very remote points from the great sources of power, for the reasons which had come out in Mr. White's paper. He did not feel that those who owned steam generating plants had much to fear from the competition of water power at considerable distance. He had heard recently a serious proposition to transmit 40,000 horse-power sixty miles at a pressure of 60,000 volts; this current to supplant the steam system in a city of some 60,000 inhabitants. A company had made some proposition to supply power in the city of Harrisburg from a falls on the Susquehanna River, at $20 per horse-power. He had advised his friends to corral as many contracts for this power as possible.

Mr. White said that the localities are few and the circumstances exceptional where a transmission line fifty miles long could be supported; there was no reason, however, to fear any trouble on account of insulation. He knew of a plant in Michigan which had been run all winter in a climate worse than that of Niagara, and had been shut down but once in four months. This was at noon on Sunday, after ample notice had been given to consumers, and lasted for ten minutes, or long enough to tighten the key on the water-wheel shaft.

Mr. C. P. Steinmetz said that it was dangerous to generalize about such matters; that the economy of power transmission depended upon what the power is used for, and whether it is to be used for a twenty-four hour day or for only a short run. Many conditions change the problem greatly, and each individual case must be investigated.

Mr. C. F. Scott said that much difficulty had been met with in the plant at Telluride, Col., with the lightning arresters. During the first season all the arresters that were sent there were destroyed by lightning; but now a new form had been provided, which gave entire freedom from difficulties with lightning. While it is probable that there could be no absolute protection, yet the same, or even more favorable, coefficients of safety may be had through these instruments, as with other parts of the apparatus.

Mr. White said, referring to Mr. Scott's remarks, that the cost of power in some places, especially in the West, was enormous. Investigation had shown that at a place such as Leadville, Col., miners were paying as much as $2000 per year for an actual indicated horse-power. At Cripple Creek fuel costs $12 a ton, and water costs 75 cents a barrel. With a 10 or 15-hp engine fired up all day long and used about once an hour for a few minutes, the figures for power cost are colossal.

Mr. W. Lea Walbank, of Montreal, described the construction of a line of steel poles for the transmission from Lachine Rapids to Montreal.

At the close of the discussion a vote of thanks was tendered Mr. White for his interesting and able paper.

Mr. Arthur Wright, of Brighton, England, presented his paper on "Profitable Extension of Electricity Supply Stations." Mr. Wright read a summary of his paper, the printed copies being in the hands of the members present.

This paper was a most interesting thesis upon the desirability of domestic lighting and of certain other forms of custom which can be secured by the use of more equitable systems of charging for current. The author contended that the only available method is the sliding scale of hours of consumption. Where gas and electricity are simultaneously used he had found that in this country, as well as in England, gas was burned for the long-hour service while the electric light was used for short hours, and regarded rather as a luxury.

A discussion of the various systems of charge, and a presentation of certain tables of results obtained from two electric-light stations in Brighton, concluded this very interesting paper.

Replying to questions of members, Mr. Wright said that the Brighton plant is direct-connected; that during the years covered about 14 cents for the first kw hour, and 30 cents each for succeeding kw hour.

by the tables it was operated non-condensing; that the longest transmission lien was about two miles, and the prices charged were

Mr. Beggs questioned Mr. Wright concerning the relative charges for gas and electricity, and gave it as his opinion that it was an injustice to cut the price of gas in half. He did not feel that we ought to cut under the price of gas. He did believe, however that the price of electric lighting must be brought down to that of gas, but that we ought not to depreciate the value of electric lighting. Mr. Beggs believes strongly in a flat rate for electricity, of the same kind as that charged for gas and water. Isolated plants are the greatest menace to central stations to-day. They are what the electric light men are called upon to compete with. He said that men were going through the country calling upon owners of large buildings, and proving to them that they can install a plant, run it a year without cost, and then declare a dividend to themselves! (Laughter.) Mr. Beggs said that Mr. Wright's methods were very complicated. He believed in a simple uniform rate as the best possible solution.

Mr. Samuel Insull, replying to Mr. Beggs, said that the question was not whether it is good policy to compete with gas; it was whether a proper return could be obtained from every customer for the investment in the plant. His company was operated on the Wright system in practice. He had also to complete with the isolated plant. This could not be done if the lowest price charged was the same proportionately as that asked by the gas companies. He had a case that required the price to go as low as four and a half cents per kw hour. He cited an instance of two buildings, practically alike. In one the average consumption of light was 200 hours a year, in the other it was about 2000 hours a year. He questioned if it was fair to charge the one on the same basis as the other. What Mr. Wright's proposition amounted to was the question of getting returns on the investment—getting a correct share of dividends from each customer.

Mr. Insull cited the case of certain districts in Chicago where there are large department stores. Unless his company was willing to do business on a basis of six cents per kw hour, equivalent to gas at sixty cents per 1000 feet, they had as well take up their conductors and get out of that territory. In these concerns gas is no competitor with the electric light, because the only illuminant that can be used in many places, such as show windows, is one that does not give much heat, and hence the electric light finds a peculiar field in these buildings. The largest building in Chicago, where there are a great number of tenants, is not a profitable customer at 20 cents per kw hour, whereas in a certain small store in State Street the proprietor pays about the same amount per annum, and his business is far more profitable at the low rate of 6 cents per kw hour.

Mr. Insull closed by absolutely indorsing the scheme proposed by Mr. Wright, and said that it would do more than anything else to make small plants successful. (Applause.)

Mr. George R. Stetson, of New Bedford, said: "We do not want to fight the light question on the ground of competition with gas. Electric light and gas are two commodities that have to be used in different places entirely." He believed that Mr. Wright was entirely correct in the principles laid down in his paper. If a person wants light for a temporary convenience it is not right that he should have the use of the capital required for its production at the same rate as one who burns the light constantly. He expressed himself as being thankful for the discussion from the two men best able to present the two sides of this important question, and believed that the just and equitable distribution of costs would make it possible for many small stations to earn a living return upon their investment.

Mr. L. A. Ferguson, of Chicago, said that the Wright system made no distinction in regard to the time of day in which the maximum load comes. In other words, it charges the same rate to a customer who has his maximum load at 5 o'clock in the afternoon as it does to one with his maximum at 3 o'clock in the morning. He thought Mr. Wright could go a step further in his system, and make a differentiation of the charge, depending upon the time of day at which the maximum load comes. In replying, Mr. Wright said that his answer to the question was that the standing charges are neither yearly, monthly nor daily. They are a charge against the whole investment. If two customers took current of equal quantities at different times of the twenty-four hours, then each should pay one-half of the proportionate charge against the investment for the generation of that current.

Dr. Fenner, of Fredonia, wished to have some details of the actual operation of Mr. Wright's system in Brighton. He had had trouble with the gas company, which dropped its price from $2.50 to $1. The consequence was that both the electric light and gas companies ran for over two years at a loss. This was now at an

end, since he had just bought the gas plant. (Prolonged laughter.) He said he wanted to make the charges satisfactory; in other words, to make some money. He also did not wish to offend citizens, and he wished to know the practical details of the Wright system, so that it might be applied to the case in point.

Mr. Wright, in replying, gave the practical details of the operation of his system in Brighton; the instruments used sum up the consumer's bills without the necessity for any calculation, and could be read by an ordinary meter reader. His company in Brighton were making a profit on their investment of 10½ per cent. In reply to further questions Mr. Wright stated that the maximum demand was measured by a recording ammeter, which is used during the four winter months, and its maximum for that time taken as the maximum demand.

After some further discussion, Judge E. A. Armstrong stated that the convention was showing Mr. Wright their great appreciation of his paper by the long discussion, and moved that a recess be taken for luncheon, so that the discussion might be resumed afterward.

AFTERNOON SESSION.

An invitation was received from the Buffalo & Niagara Falls Electric Railway for a special excursion to Tonawanda and return. This was accepted, and a vote of thanks returned for the invitation.

Mr. Henry Reason, of Brighton, England, at the request of the president, gave the association some information in regard to the working of the Wright system at Brighton. He said it was in use in forty cities in Great Britain. In Northampton and Preston it had made non-supporting stations pay dividends. In 1896 the Brighton station had set aside 5½ per cent. upon its capital, and had earned in addition the net sum of $30,000. He thought that the system gave the station manager a perfect answer to the dissatisfied customer. He had heard some gentlemen say that a central-station manager's life was not a happy one. He felt rather like boasting that at Brighton they could go home to tea every evening, and at night could sleep with the consciousness that they were at least losing nothing.

At the conclusion of Mr. Reason's remarks, Prof. Charles A. Carus-Wilson, of McGill University, Montreal, read a paper entitled "The Induction Factor; a New Basis of Dynamo Calculation and Classification." This paper was not read in full by Professor Carus-Wilson, as it was of a mathematical and technical nature. Its chief point was the desirability of adoption of some method of classifying dynamos and motors different from that now used. In the system proposed the "induction factor" would be found very useful in a number of calculations, and in the application of the machines to the work designed for them. A vote of thanks attested the appreciation of the association for the valuable contribution of Professor Carus-Wilson.

The next paper was by Prof. Elihu Thomson, and was entitled "Recent Progress in Arc Lighting." An abstract of it appears in another column. This more than ordinarily interesting and instructive paper was received with the greatest attention. It elicited a round of hearty applause and the thanks of the association were voted to Professor Thomson for the instruction and entertainment he had provided for it.

The session was concluded by the presentation of Mr. T. Commerford Martin's paper on "The Daylight Work of Central Stations." Mr. Martin made a few humorous remarks concerning the object of the printing of papers in advance, and said that he would read his by title only. A vote of thanks was tendered Mr. Martin, and the convention adjourned for the day.

Immediately after the close of the session a visit was paid to the works of the Carborundum Company, where the visitors were entertained with a view of the electric furnaces in operation.

At 8:30 in the evening Mr. L. B. Stillwell, electrical director of the Niagara Falls Power Company, delivered an illustrated lecture in the Park Pavilion, upon the subject of "Niagara Power." This lecture was of a popular description, and proved highly entertaining to the large audience which crowded the hall.

THURSDAY, JUNE 10.

MORNING SESSION.

The convention was called to order by the president at 10:45, and Mr. B. F. Lamme, of Pittsburg, was called upon to read his paper, entitled "Polyphase Motors." This paper is probably the first authoritative presentation of the subject of polyphase motors that has been made, and was listened to with the deepest attention on the part of the members present. Mr. Lamme used twenty-four large diagrams for the illustration of his paper, and presented the details of construction and design of the various motors. His long experience in this class of work and his complete familiarity with the subject gave additional value to his remarks. At the conclusion of his paper, the association, after a vote of thanks to Mr. Lamme, went into executive session, at the end of which recess was taken for luncheon.

AFTERNOON SESSION.

The convention was reopened at 3 o'clock, when Lieut. F. Jarvis Patten, of New York, presented his paper on "Frequency Transformation," which will be found in another column. At its conclusion a vote of thanks was presented to Mr. Patten, and Mr. C. F. Scott, of Pittsburg, was introduced to read his paper on "Rotaries for Transforming Alternating Into Direct Current.." This paper was a very complete exposition of the laws governing the action of such machines, and included a most lucid explanation of their functions and operation. Mr. Scott is so well known by his work in connection with the design of machines of this character that his exposition of their operation possessed thereby additional value and interest. The usual vote of thanks was tendered to him at the conclusion of his paper.

The report of the Committee on Standard Candle Power of Incandescent Lamps was presented by Mr. James I. Ayer, Dr. Louis Bell, the chairman of the committee, not being present.

The object of this committee is to set forth a suitable specification for standard incandescent lamps. In order to do this properly it was necessary at the outset to deal with three subjects: First, the determination of a standard of light; second, the provision of specifications for a direct, simple and rapid method for testing lamps with reference to this standard; and third, the specification of a normal standard of light. After a review of the present standard lamps, candles, and other sources of illumination, and a brief disquisition upon photometers, the report related that the co-operation of the American Institute of Electrical Engineers in this work had been requested and obtained, the matter being referred by the Institute to its Committee on Units and Standards. The recommendations of the committee with regard to the standards, etc., were as follows: The Hefner-Alteneck amylactic lamp was recommended for a standard. The Lumer-Brodhun photometer screen was recommended for the photometric measurements. It is recommended that lamps to be tested shall be revolved upon their axis at the rate of approximately two revolutions per second during the test, and that the rate of lamps shall be in mean spherical candle power. The committee, in recommending the Hefner-Alteneck standard, did not intend that the use of this standard should be the ordinary means of making the photometric measures, but that from it standard lamps should be prepared to serve as commercial secondary standards of light. These lamps, of a uniform size and with uniform filaments, were to be manufactured without any marks of identification by various reputable manufacturers and submitted to the committee, which would then proceed to have them standardized carefully, in certain testing laboratories to be selected, under the most rigorous conditions of fairness, and distributed as the commercial secondary standards. These were to be provided with a fiducial mark, so that when they were used with this mark in a certain position, their light would be equivalent to that due to the revolution of a lamp of 16 mean-spherical candle-power. The present measurement of horizontal candle-power is objectionable on many accounts. It was therefore determined by the committee that the only fair and proper unit for consideration was the mean-spherical candle-power. The practical measurement of this, however, is difficult, and it was recommended that as a more simple means for obtaining the average luminous output of the lamp a measurement be taken in the direction inclined 45° to the axis of the lamp, while the lamp is revolving upon its axis, the distance of the lamp from the photometric screen to be regarded as the distance between the centre of the axis of its bulb and the screen. This will furnish a fair approximation to the mean-spherical candle-power, and reduce the amount of labor in measurement to the minimum. Under these conditions the actual process of testing should not require more than fifteen to thirty seconds per lamp. The normal commercial standard should be made definite. It was not considered wise by the committee to introduce conditions of efficiency, etc. The variations of luminosity with the time are important, but the committee

felt that limits should be set, and that they should be drawn so as to meet the conditions of ordinary manufacture. It was therefore recommended that a 16-cp lamp should be one that lay between 15.5 and 17 candle-power. It is proposed to publish later a description and specifications of a simple, cheap, standard photometer. After some questions by various members present, Mr. Samuel Insull recommended the adoption of the report, and after some further discussion, his motion was carried. A committee was appointed to prepare the customary resolutions for the retiring president. Upon the motion of Mr. James I. Ayer it was agreed that the incoming president should appoint a committee to take up the question of amendments to existing freight classifications on electrical goods and apparatus. Mr. Ayer stated that under the present classifications there were frequently considerable hardships, that, for example, the iron frame of a dynamo, if shipped alone, had to pay double-extra first-class freight rate as electrical machinery, although it contained nothing more than cast-iron.

President Nicholls made a few appropriate remarks touching the loss which the association had suffered during the year in the deaths of Messrs. Harrison J. Smith, of New York, and J. M. Orfutt, of Boston. At the conclusion of these, the convention went into executive session for the election of officers. This resulted in the following gentlemen being chosen for the ensuing year: Mr. Samuel Insull, of Chicago, president; Mr. A. M. Young, of Waterbury, Conn., first vice-president; Mr. George R. Stetson, New Bedford, Mass., second vice-president. The following gentlemen were chosen as members of the executive committee: Mr. Frederick Gilbert, of Boston; Mr. W. Worth Bean, of St. Joseph, Mich.; Mr. Stevens, of Elizabeth, N. J.; Mr. W. M. Lea Walbank, Montreal.

The question of the meeting place for next year will be decided later by the Executive Committee, as is the custom of the association.

A FEW OF THOSE PRESENT AT THE CONVENTION.

Humors of the Electric Light Convention.

When it was announced that the National Electric Light Association would meet at Niagara Falls the inhabitants of the town prepared to receive a body of staid scientists of the type of Professor Dryasdust—men devoid of merriment, but with preponderating intellect. When, therefore, the convention assembled the natives bowed their heads in awe, but found it necessary to raise them and keep both eyes wide open in order to see all the fun that went on.

The early arrivals, led by those two jolly wiremen, Captain Candee, of New York, and Mr. John Carrol, of Montreal, had a brass band to meet and escort to the hotel the passengers of the incoming special train from the East. As the procession marched hilariously through the streets at the winsome hour of midnight, an eager bystander who sought the distinguished among the delegates inquired: "Which is Tesla?" The portly figure of Mr. Fred Gilbert, of Boston, who was vigorously assisting in the pounding of the big bass drum, was pointed out. The Niagara Faller shook his head sadly, and went off with the air of a man whose fondest hope had been rudely shattered. The air he went off with was, "It Was Only a Dream."

For those whose taste rose superior to the music of the brass band a hand-organ was provided, which filled the corridor of the International Hotel with the classic strains of Meyerbeer, Wagner and other composers, though even these seemed ground for complaint when the Dago owner of the hand-organ heard the rapid rate at which "Billy" Low, "Scrib" and others in turn performed these masterpieces. Simultaneously with this part of the programme, a supply man who should have been put off at Buffalo kept insisting boisterously that his love was a high-born lady, though no one seemed to evince the slightest interest in the matter one way or the other.

When some of the visiting members of the Postal Congress called to obtain copies of THE ELECTRICAL WORLD containing the article on the "Electrical Features of Niagara," which they wished to carry back with them to their respective homes beyond the sea, they found a cake-walk in progress, led by Mr. John Carrol, of Montreal, and Miss J. H. Dale, of New York, who, it is needless to say, took the cake. The members of the congress hold high official positions in their countries, and were so impressed by the sparkle of the electric light convention that they will no doubt endeavor to incorporate electric lighting as well as telegraphy with the Post Office services with which they are connected, and inaugurate similar conventions in their own benighted lands.

Professor George T. Manson, the well-known savant of the Okonite Company, performed an interesting and important experiment during the convention. Finding a negro waiter of the International Hotel in a corner where he could not get away, the distinguished scientist squirted four siphons of seltzer, one after the

other, over the unappreciative Ethiopian. The appearance of the negro, as he rushed through the corridors covered with dismay and seltzer, is easier to imagine than describe. He was subsequently the recipient of a roll of Manson tape and another of dollar bills for the unwilling part he took in the experiment, so that from his standpoint as well as that of the learned professor the demonstration was a complete success.

Although the exhibits were fewer than usual, advertising at Niagara Falls was carried to a greater extent than at any previous convention. The "boys" considered that a prominent electrical supply house was not as well represented in the electrical journals as the volume of its business warranted. They therefore purloined the night apparel of one of the company's salesmen, embellished it with an attractive announcement and displayed it prominently in a part of the caravansary much frequented by weary and thirsty pilgrims. The supply of Appolinaris was entirely exhausted in the effort to assuage the curiosity of those who wished to gaze upon that advertisement.

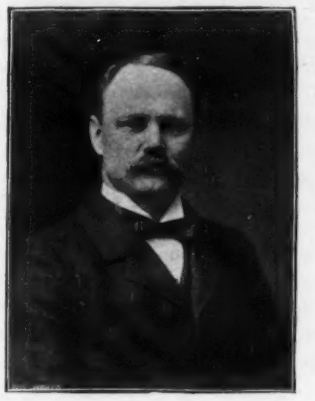
Humorously, as otherwise, the convention was a success.

The New Officers.

Mr. Samuel Insull, the newly-elected president of the National Electric Light Association, is by birth an Englishman. He began life as a clerk in an insurance office in London. Coming to this country at a time shortly before the exploitation of the incandescent light, he became associated with Mr. T. A. Edison, and soon came to be general manager of the Edison General Electric Company. Leaving this service he became president of the Chicago Edison Company, which office he still holds. Mr. Insull has been for several years prominent in electric light matters, not only on account of the high position he enjoys, but as well by reason of his active interest in all matters pertaining to his profession. He has been for years an active and valuable member of the National Electric Light Association, and his election to its highest office is a worthy compliment to his useful and continuous service.

President Samuel Insull.

Mr. A. M. Young, of Waterbury, Conn., the newly-elected first vice-president of the National Electric Light Association, is one of the most widely known and active men in the electric light business. His interests are very large and represent a vast amount of invested capital. Mr. Young is the secretary of the Waterbury Traction Company, president of the New England Engineering Company of Waterbury, president of the Central Railway & Electric Company of New Britain, Conn.; president of the Suburban Electric Company of Elizabeth, N. J., and president or director of about twenty other electrical corporations. Mr. Young has not previously held office in the association, but has been for many years an active and valued member.



First Vice President
A. M. Young.

Secretary
Geo. F. Porter.

There are probably few men connected with the National Electric Light Association who have been more prominent and active in its development and betterment than Mr. George F. Porter, the genial and universally liked secretary of the association. Mr. Porter, owing to his position, is known by the entire electrical fraternity, and has endeared himself not only to the members of the association, but all who know him. It is, therefore, very much to be regretted that the association will shortly lose the services of this gentleman, who will soon join Mr. W. R. Brixey, and represent that concern in New York City, in place of Mr. J. E. Ham. Mr. Porter began life as a civil and mechanical engineer. It was in 1875 that he turned his attention to electrical work, commencing as a telegraph operator. Ultimately he became connected with the Pullman Palace Car Company, and later with the Westinghouse Electric & Manufacturing Company at its Philadelphia office. During Mr. Huntley's term as president of the association he was appointed secretary, in which position he has given such universal satisfaction that it has been held by him ever since. Many regrets will be expressed by all who hear of Mr. Porter's resignation. He carries with him, however, to his new field of action the good will and best wishes, not only of the association, but of everyone electrically interested.

Convention Notes.

The Standard Carbon Company, Cleveland, Ohio, was represented in a most dignified fashion by Mr. A. D. Spear.

Mr. J. P. Coghlin was highly successful in promoting the interest of the Central Electric Company, Worcester, Mass.

Mr. Jas. H. Mason, of the Simplex Electrical Company, was present at the convention, and everybody as usual was glad to see him.

Tellmic Stone Ware and glazed ducts are excellently described in a pamphlet which will be kept for future reference by those who got them.

Mr. T. Carpenter Smith, of M. R. Muckle, Jr., & Company, represented the Keystone Electric Light & Power Company, of Philadelphia.

Flagg Insulating Joints for combination and all electric fixtures were prominently brought to the notice of everybody by Mr. George L. Peeples.

Messrs. Pass & Seymour, Syracuse, N. Y., exhibited their all-porcelain junction boxes and other specialties, of which many flattering comments were heard.

Mr. B. G. Underwood was the special representative of the Boston *Herald* at the convention. His detailed reports of the proceedings were published in full.

MR. LUTHER STIERINGER, that pioneer participant in electrical conventions, was strongly in evidence. The few who did not know him were anxious to meet him.

CUMMINGS UNDERGROUND CONDUIT, although it needed no introduction to the electrical fraternity, was well looked after by Messrs. J. F. Austin and J. F. Cummings.

MR. P. H. HOVER, who came from the New York office of the New York Insulated Wire Company, vied with Mr. Wolff in showing the popularity of the New York Company's product.

CAPT. W. L. CANDEE and Mr. George T. Manson represented the Okonite wires and cables. They distributed a unique key-shaped pencil, which many used to write orders for "Okonite."

MR. C. E. BIBBER, of the Bibber-White Company, Boston, the "diminutive, but lively," was here, there and everywhere. He never misses a point, and this convention was not an exception to the general rule.

MR. ALBERT B. HERRICK, of Herrick & Burke, New York, was frequently interviewed regarding central-station design and construction, of which Mr. Herrick is most excellently fitted to speak with authority

BUCKEYE LAMPS were shown in many forms and sizes in an ornamental case at the convention headquarters. Their merits were fully extolled by Mr. Bailey Whipple, Mr. John Rice Massey and Edward L. Nash.

MR. T. KIELEY, of Kieley & Mueller, steam heating and engineering specialties, New York, showed to all interested some of his concern's latest steam controlling specialties, one of which was exhibited in operation.

KEYSTONE measuring instruments were exhibited by Mr. Stevens, whose excellent description of the various "good points" about them was always listened to with interest by all who came within hearing distance.

THE LAKON COMPANY, Elkhart, Ind., was represented by its president, John C. Boss. Mr. Boss knows that his company's product is of surpassing merit and hence had no difficulty in bringing others to this belief.

THE NEW YORK & OHIO COMPANY, Warren, Ohio, manufacturer of Packard lamps, and transformers, was represented by Mr. W. D. Packard. Mr. Packard showed that he knew how to make friends for Packard products.

MR. THOMAS I. MCLEOD, of the firm of McLeod, Ward & Co., New York, expatiated on the Kinsman desk lamp and other specialties manufactured by this company. Mr. McLeod is always a welcome visitor at the convention.

MR. T. H. BRADY, of mast-arm fame, and an old timer at conventions, told about mast-arms, hoods and cutout boxes, which he now makes. Mr. Brady's material is so well known that an exhibit of it was entirely unnecessary.

MR. GEORGE CUTTER, of Chicago, of "Why Don't that Lamp Drop" fame, simply walked about the convention headquarters and met everybody. He did not exhibit anything, as the things that "Cutter" makes are already so well known.

MANAGER J. W. LIEB, JR., and Chief Inspector Arthur Williams, of the Edison Electric Illuminating Company, New York, were always busy discussing some of the important problems connected with the operation of large central stations.

THE STANDARD UNDERGROUND CABLE COMPANY'S interests were well looked after by Messrs. G. L. Wiley and T. E. Hughes, of the New York office. Both were tireless in their efforts to impress upon those interested the virtues of Standard cables.

MR. L. L. ELDEN, inventor of the Elden automatic machine circuit breaker was at the convention and spent a goodly portion of his time at the exhibit of L. A. Chase & Co., his agents, explaining the special merits and advantages of his device.

THE BIBBER-WHITE COMPANY, of Boston, makes and sells things electrical. It makes good things, and consequently sells lots of them, but this is probably somewhat owing to the fact that Mr. Charles E. Bibber, treasurer of the concern, is liked by everybody.

"RAIL BONDING AND THE PROTECTED RAIL BOND" was the title of a neat leather-bound booklet distributed by the Forest City Electric Company, of Cleveland, Ohio, and which was read with interest. This rail bond is only one of the many good things handled by this concern.

MR. "BOB" COREY was there in full force. He came early and stayed late; making sure that all who met him were fully informed as to the value of Columbia incandescent lamps, and Simplex wire and cables. It seems strange to find Mr. Corey divorced from arc lamps.

THE CENTRAL ELECTRIC COMPANY, of Chicago, did not exhibit. It was, however, most ably represented by Messrs. George A. McKinlock and H. E. Adams, whose pleasant greetings were an assurance that the Central Electric Company would try to do its best to please in every particular.

COL. J. H. SHAY was one of the old timers at the convention. The Colonel, who is the Philadelphia representative of the Charles Munson Belting Company, of Chicago, did not need to go about to meet those he knew, for he knew everybody and everybody knew him and the Munson belts.

MR. H. H. BROOKS represented the American Circular Loom Company. While he did not forget the well-known "canvas jacket," he grew enthusiastic over the new conduit tube "electroduct" about to be brought out by his company. The sample which he exhibited aroused general interest.

CHARLES K. KING, manager of the electric railway department of the Ohio Brass Company, Mansfield, was accompanied by Mrs. King. He said that he only came as a visitor to the convention, but those who met him desired to know about the various specialties manufactured by the company.

MR. H. P. MOORE, of the Shawmut Fuse Wire Company, Boston, represented it at the convention, presiding over the company's handsome exhibit of fuses and Linton & Southwick switches in a very creditable manner. Mr. Moore is a young man, but knows his business and how to make friends.

MESSRS. S. M. HAMILL, COL. W. S. ROGERS AND H. J. DOUDS represented the Brush Electric Company, of Cleveland, Ohio. The new multi-circuit arc light dynamo aroused much interest, and its principle of operation was always most instructively described to those who were not familiar therewith.

MESSRS. FREDERIC NICHOLLS, president of the association; George W. Watts, T. A. Campbell, J. W. Campbell, E. H. McCormick and F. C. Armstrong came forth from various parts of the Continent to advance the interests of the Canadian General Electric Company, Toronto, and the association.

MR. JAMES BRADLEY, of the Bernstein Electric Company, Boston, was present at the convention, and was greeted most kindly by old and new friends. The Bernstein lamps have lost none of their popularity, and are quite sure not to lose any of it through the efficient management of Mr. Bradley.

THE BREWSTER ENGINEERING COMPANY, New York, was represented by Mr. T. C. Brewster. Mr. Brewster's company is agent for the Bossert Electric Company and Belknap Motor Company, whose exhibition room was his headquarters.

MR. SAMUEL INSULL, of the Chicago Edison Company, was one of the prominent central-station men present at the convention. It is stated that the stock of Mr. Insull's company pays larger dividends than that of any other similar concern.

MR. A. H. PEASE, of the Hart & Hegeman Manufacturing Company, Hartford, Conn., met at the convention old friends and made new friends, not only for himself, but for his company's famous switch specialties, receiving hearty congratulations over the new designs of Hart switches now being marketed.

THE INTERESTS of H. M. Underwood & Company, of Chicago, Ill., were well taken care of by Mr. Underwood, whose clear exposition of the new Cloos high-potential junction box for the distribution of alternating and direct currents underground was thoroughly appreciated by all who visited the exhibit.

SCHEEFFER TRANSFORMERS and wattmeters needed no better advocate than the inventor, Mr. G. A. Scheeffer, who represented his concern, the Diamond Electric Company, of Peoria, Ill. A booklet entitled "Scheeffer Transformer" tells a great deal about transformers in general and the Scheeffer transformers in particular.

I. T. E. circuit breakers and motor starting boxes were displayed by the Cutter Electrical & Manufacturing Company, Philadelphia, Pa. Messrs. H. B. Cutter and H. B. Kirkland exploited the merits of I. T. E. apparatus, including the new high and low load motor-starting boxes. Flush switches were, however, not forgotten.

SENATOR FOSTER M. VOORHIES, who is very much interested in electrical matters, attended the convention as a guest of Mr. A. M. Young. The Senator was very much sought after on legal matters connected with the electrical industries, and his pleasant reception of all he met was his most striking characteristic.

THE ROCKWOOD MANUFACTURING COMPANY, of Indianapolis.

Ind., was represented by Mr. G. O. Rockwood, who showed a paper pulley, that certainly had most remarkable advantages. The little model which Mr. Rockwood exhibited clearly demonstrated the value of these pulleys over those of the ordinary metal type.

Mr. Charles F. Munder, the treasurer and manager of the Davis Electrical Works, Springfield, Mass., was at the convention to talk about the incandescent lamps made by his company. It did not take Mr. Munder very long to convince all with whom he came in contact of the high grade of Davis incandescent lamps.

The H. B. Camp Company, through its representative, Mr. A L. Daniels, was particularly desirous that everybody should see its new vitrified clay-armored interior conduit. At this time when conduits are attracting such general attention, the new production aroused a great deal of interest. Samples were freely distributed.

The Interior Conduit & Insulation Company was well represented by Mr. V. Clarence Durland, E. E. Although Mr. Durland talked about other things, he particularly discussed the merits of the new interior conduit made by his company, and the arguments put forth by him in favor of lined conduit were very strong.

The Bryan-Marsh Company, New York, manufacturer of the Imperial incandescent lamps, was ably represented by Mr. John I. Solomon. The reputation of the lamps is so great that the company concluded that an elaborate exhibit was unnecessary. Mr. Solomon carried in his coat pocket all that was needed for the exhibit.

Mr. A. M. Young, the past first vice-president of the association, although a very busy man, left his many private interests and gave up his time to the association during the convention. Mr. Young's electrical interests, as is well known, are very large, he being officially connected with nearly two dozen electrical companies.

The Fort Wayne Electric Corporation was represented at the convention by Messrs. C. S. Knight, J. J. Wood and Thomas Duncan, of Fort Wayne; Manager Philbrook, of the Rochester office, and F. A. Wunder and John C. Lott, of New York. With such an array of excellent advocates, an exhibit was, of course, unnecessary.

The Mitchell Tempered Copper Company, producers and manufacturers of pure copper castings for electrical appliances, Corry, Pa., exhibited various samples of their product, which were inspected with great interest. The company was represented by Messrs. Dan Mitchell, superintendent, and Mr. J. G. Ruhl, secretary and treasurer.

The "Glad Hand" hung from many lighting fixtures in the International lobby. It is made of glass, hollow inside, illuminated by an incandescent lamp, and the index finger is used as a pointer to designate some place of interest. The "glad hand" should also point to its manufacturers, the Phoenix Glass Company, of New York.

The Peru Electric Manufacturing Company, Peru, Ind., exhibited on a large and well-arranged board a handsome display of their porcelain insulators, tubes, switch bases, and many other electrical devices made of this material. Mr. D. A. Schutt, who was in charge of the exhibit, was a perfect encyclopedia of porcelain and its uses.

The John A. Roebling's Sons Company, New York, was represented by a most happy triumvirate—Messrs. H. L. Shippy, manager; G. W. Swan and Marston R. Cockey. Regarding wires and particularly bimetallic wires, there was much said by all there, but the last-named gentleman was particularly warm in his praises of that wire.

The McIntire Arc Lamps clearly showed that the range of size of such devices is almost unlimited. The inventor of these lamps, Mr. G. R. McIntire, representing the International Arc Lamp Company, of New York, extolled the merits of his baby lamp, which he exhibited in conjunction with a number of highly artistic arc lamps of larger size.

Mr. "Jim" Wolff, of Chicago, was one of the wire fraternity at the convention. There were others, but Mr. Wolff, of Chicago, who takes care of the New York Insulated Wire Company's interests, was so particularly suave and pleasant that everybody who did not know him was anxious to become acquainted with him and the things he sold.

Mr. John T. McRoy, of Chicago, though very popular and much sought after, did not forget that he had business to attend to, and must advance the interests of his vitrified-clay conduit, which he did to perfection. It was said by some that if the conduit is as smooth as Mr. McRoy is suave, it certainly must be a most excellent production.

The Partrick & Carter Company, of Philadelphia, made an exhibit of the numerous electrical specialties manufactured by this pioneer concern. One of the mottos which hung above their exhibit read: "Our health is good, consequently we are in business for something else." Mr. E. Ward Wilkins, of the firm, was at the convention part of the time.

The Electric Appliance Company, of Chicago, could have no better representative than Mr. Willard W. Low, its president. Mr. Low told about the best specialties handled by his concern. It took him some time to do so, because he said they were all best, and there were many of them. The game counters distributed by Mr. Low were highly appreciated.

The National Conduit & Manufacturing Company, of New York, is already famous, not only as a manufacturer of conduits, but also of underground cables. The company was represented by the secretary and treasurer, Mr. James P. McQuaide, who, although he got to the convention at a rather late date, took in everything, including some prospective orders.

The Shawmut Fuse Wire Company, of Boston, could have no better representative than Mr. H. P. Moore. Mr. Moore said that Shawmut fuses were accurately tested and most uniform in quality. Nothing else could be expected of goods manufactured under Mr. Moore's supervision. The company also makes an excellent line of switches, which were on exhibition.

Mr. Charles D. Shain has been so long and so well known in the electrical trades that he felt at home at the convention. Mr. Shain represented the interests of the Stevens flush switch and other specialties manufactured by the Electric Protection Company. Mr. Shain was the only man at the convention who braved the terrors of a June climate at Niagara with a straw hat.

Adams-Bagnall lamps made by the Adams-Bagnall Electric Company, Cleveland, Ohio, were exhibited in many forms and artistic designs, by Mr. T. E. Adams, Those who saw the lamps burn and listened to Mr. Adams' description of their excellent features certainly decided not to forget the Adams-Bagnall Company when they wanted arc lamps of any kind.

Mr. Sears B. Condit, of L. A. Chase & Co., Boston, at the convention, was, as always, a personal success through his apparently inexhaustible wit and humor, and captivated everybody on behalf of the Elden alternating-machine circuit-breaker, and the Chase junction box and coupling for iron-armored conduit work, both of which were attractively exhibited.

The Hyperion Arc Lamp, an extremely ingenious alternating current, inclosed type, embodying a number of new and novel features, was exhibited by the Midland Electric Company, of Chicago. Mr. Joseph Kettlestrings took great pleasure in describing it to everybody interested in such apparatus. This lamp is adapted to operate with a cheap grade of direct-current carbons.

Mr. C. O. Baker, of Baker & Co., platinum refiners, New York, was one of the busiest men at the convention. His interest in his concern and its business seemed to be entirely secondary to his herculean labors in looking after the transportation and general welfare of those in attendance. The thanks of the entire association and its guests can but partially reward him.

Mr. C. B. Price, of the Pettingell-Andrews Co., Boston, and Mr. D. C. Durland, of the New York office of the Interior Conduit Company, were inseparable at the convention, and both of them were always ready with good strong arguments and demonstrations of the fallacy of the plain tube. Both of these gentlemen have made a special study of interior conduit in all its bearings.

The Brodie Electric Company, of Manchester, N. H., was represented at the convention by Mr. J. Brodie Smith, inventor of this company's important electrical specialties, which include tree insulators, porcelain fuse box for transformers, automatic motor switches and others, important improvements in all of which have been recently introduced, particularly the automatic motor switch.

Of the Boston Contingent there were none more eagerly sought after than Commissioner Thos. W. Flood, of the Wire Department, Boston; Capt. Wm. Brophy, chief electrician of the Wire Department; Mr. F. A. Gilbert, president Boston Electric Light Company; Messrs. F. M. Kimball, Chas. B. Davis, Sidney B. Paine, A. R. Rush and Caryl Haskins, of the General Electric Company.

Mr. P. C. Ackerman, the New York representative of the American Electrical Works, Providence, R. I., sounded the praises of

his company's wires of all kinds. An electric light convention would not be a complete success without the presence of Mr. Ackerman, who is a regular attendant at these gatherings. Mr. Frank B. Baker, also represented the company, coming directly from Providence.

JANDUS ENCLOSED ARC LAMPS were exhibited by the Jandus Electric Company, of Cleveland, Ohio. This lamp is the well-known lamp handled formerly by the Manhattan General Construction Company. Mr. Bailey Whipple, of the Buckeye Company, is also associated with the Jandus Company. Buckeye incandescent and Jandus arc lamps were alternately the topic of Mr. Whipple's eloquence.

THE BRYANT ELECTRIC COMPANY was very ably represented. There were men from the East and men from the West, and Mr. Waldo C. Bryant was there himself. Mr. Bryant talked switches and sockets and other things, but Mr. L. W. Eaton, E. M. Scribner and E. G. Grier vied with him until it was doubtful who won the honors. Mr. Edward R. Grier, the Western manager, was accompanied by Mrs. Grier.

THE AUTOMATIC CIRCUIT BREAKER COMPANY, of Newaygo, Mich., had a neat exhibition board in the convention headquarters. Mr. A. G. Runnels, treasurer of the company, took great interest in bringing out the merits of the improved circuit breaker made by his company. Mr. Runnels said he was not an electrician, but he certainly knew all about circuit breakers. The new device is exceedingly simple and positive.

THE PETTINGELL-ANDREWS COMPANY, of Boston, Mass., was represented by Secretary C. B. Price, who was accompanied by Mrs. Price. Mr. Price talked of all the good things his concern puts forth. He had a very acceptable souvenir in the form of a leathered-covered morocco case for Underwriters rules. The Golden Rule of electrical construction, Mr. Price says, is "use interior conduit and Okonite wire."

THE PURITAN ARC LAMP will never fail to shine as long as Messrs Stewart W. Wise and Malcolm H. Baker bring its many good points so eloquently to the front as they did at the convention. A row of alternating Puritan enclosed arcs shone brilliantly on the hotel porch at night. The new series enclosed arc Puritan lamp is most promising. Mr. Baker was kept very busy describing the lamp on exhibition.

THE WIEMAN long-burning open-air arc lamps were exhibited in operation directly in front of the main elevator to the International Hotel. A life of 75 hours with one carbon trimming is obtained by the use of flat upper and lower carbons. Unlike other lamps of this type, the arc was particularly steady. This lamp is manufactured by the Wieman Electric Company, of Washington, Pa., and aroused a great deal of interest.

MR. JOHN P. COGHLIN, manager of the Central Electric Company, Worcester, was a visitor to the convention, and made numerous acquaintances and many friends. As the inventor of the Chase junction box and coupling for iron-armored conduit work Mr. Coghlin spent a great deal of his time at the exhibit of L. A. Chase & Co., where this important specialty was nicely presented, and explained to all its acknowledged value, simplicity and economy.

P. & B. COMPOUNDS, made by the Standard Paint Company, New York, were explained to all by Mr. H. W. Benedict, the New York representative, and Mr. F. S. Howard, the Chicago representative of their manufacturers. Among the latest productions of their concern is a new tape, samples of which were distributed. Both gentlemen were kept busy endeavoring to comply with requests for their very elegant little pocket-book souvenir.

MESSRS. EDWARD H. BENNETT, JR., and B. C. KENYON came from New York to represent the Diehl Manufacturing Company, of Elizabethport, N. J. They spoke of fan motors particularly, and told of the wonderful '97 fan, which operates, they say, with about one-half the current consumption of any other. Even before reaching the convention, everybody on the New York special discovered that both Messrs. Kenyon and Bennett knew all about "Diehls" of every description.

MR. LEONARD REQUA, treasurer and general manager of the Safety Insulated Wire Company, New York, felt very well satisfied with the outlook. Mr. Requa undoubtedly had good reason to feel pleased with the Safety wire, when it is considered that he had just returned from Detroit, where his company had been awarded the contract by the City Commission for underground cables.

MR. JAMES I. AYER, general manager of the American Electric Heating Corporation, of Boston, Mass., played a prominent part at the convention, both in his capacity as ex-president, as a very active member and as representative of the new art of electric heating. Rheostats and heaters manufactured by this company and exhibited under Mr. Ayer's supervision attracted much attention and favorable comment.

MR. JOHN CARROLL, of Montreal, came forth in all his glory and humor to represent the American Electrical Works. He did so most efficiently. While Mr. Carroll attended strictly to business, he at the same time permeated the convention with a spirit of good nature which made him a popular acquisition. As one of the winners of the famous cakewalk, Mr. Carroll will be long remembered by all present.

NEWTON APPLIANCES, including flush switches, fixture and arc switches, bug cut-outs, etc., needed no better advocate than the deviser of these excellent specialties—Mr. W. J. Newton himself. While Mr. Newton spoke of many things electrical, he most strenuously asserted that his switches had no "bugs," and his "bugs" never switched off. A coat-pocket exhibit of bugs and switches attracted attention and approval.

MESSRS. K. MCLENNAN CO., of Chicago, were represented by Mr. M. J. Isaacs, their business manager, who had an ample supply of samples of Gales commutator compound, which he freely distributed. In order to prove the efficacy of this material, Mr. Isaacs arranged for a test to be made on some of the motors and dynamos exhibited, the results being most satisfactory and clearly demonstrating that the use of Gales compound saves commutators.

MR. ELMER P. MORRIS took good care of the interests of the McGuire Manufacturing Company's car trucks, Keystone Electrical Instrument Company's measuring instruments, the Electric Railway Equipment Company's, Nowotny Electric Company's and Simonds Manufacturing Company's goods. Mr. Morris collected the various apparatus manufactured by these concerns and formed a sort of composite exhibit, and by superhuman efforts did justice to all.

MR. E. G. BERNARD came from Troy to tell about the excellent dynamos and motors manufactured by the E. G. Bernard Company. He particularly mentioned the new multipolar dynamos and motors brought out by his company, which involve many new features, and it is claimed by Mr. Bernard are capable of extraordinarily efficient operation. The single-piece magnetic-circuit motors and dynamos are already well known, but Mr. Bernard also spoke of their virtues.

THE CARBORUNDUM WORKS was one of the most interesting and instructive of the points visited by delegates to the convention. Samples of this "harder than sapphire" material were freely distributed and much admired for their beautiful coloring. "What is it?" was asked by many, but these were readily satisfied when informed that it was, with one exception, the hardest substance known, and was fully described in THE ELECTRICAL WORLD'S convention number.

MR. M. L. LIVINGSTON, of the Standard Thermometer & Electric Company, Peabody, Mass., was at the convention and made hosts of friends. He was every ready to explain the many important features of the arc lamps manufactured by this company, particularly the "Upton Midget Enclosed" lamp, which is now attracting so much favorable attention. The Standard Thermometer Company is certainly fortunate in having such an able representative as Mr. Livingston.

THE AMERICAN DISTRICT STEAM COMPANY, of Lockport, N. Y., which is so well known in connection with the Holly underground steam distribution system, was represented at the convention by Messrs. B. D. Hall, president of the company; I. H. Babcock, treasurer, and William D. Hall, engineer. These three gentlemen made perfectly clear to all central-station managers that the Holly system, wherever it could be advantageously used, meant dollars and cents added to the dividends.

MR. JAS. F. CUMMINGS, president of the Armorite Interior Conduit Company, was one of the most picturesque figures at the convention. So greatly has the demand for Armorite conduit increased, that the company has found it necessary to secure larger manufacturing facilities at Second Avenue and Brady Street, Pittsburg, Pa., where, with one of the most modern and improved up-to-date conduit plants that could be devised, the company hopes to be able hereafter to fill all orders promptly.

MR. A. D. NEWTON, of the Eddy Electric Manufacturing Company, Hartford, Conn., circulated quietly but effectively, and, as al-

ways, everybody was glad to see him. Mr. Newton's popularity is equalled only by that of the Eddy apparatus, which required no special exhibit at the convention. Mr. S. M. Blake, of Elmira, N. Y., and Mr. John A. Stewart, of Cincinnati, Ohio, both of the agency corps of the Eddy Company, were present with Mr. Newton at the convention and shared honors with him.

Mr. John H. Dale, of the Dale Manufacturing Company, New York, brought to the notice of almost everybody the great variety of fixtures and appliances manufactured by his company. Dale fixtures and fittings have a most excellent reputation, and judging from the popularity of Mr. Dale they must be in great demand. Everybody knew Mr. Dale and seemed to feel under obligations to him for his entertaining and enthusiastic participation in the long-to-be-remembered cake-walk of Tuesday evening.

The Electric Arc Lamp Company exhibited in actual operation some of its recent productions in enclosed arc lamps, and many of the visitors were anxious to inspect the "Pioneer" lamp, and incidentally to receive a very elegant silver match box, which was distributed as a souvenir. Mr. J. H. Astruck and Louis B. Marks, M. M. E., chief electrician of the company, were both present. Mr. Marks is not only an authority on "Pioneer" 150-hour enclosed arc lamps, but also on questions appertaining to arc lighting in general.

Mr. H. C. Adams, Jr., secretary of the Phillips Insulated Wire Company, of Pawtucket, R. I., did some excellent work for this company at the convention. Mr. Adams is a comparatively young man, but has nevertheless had considerable experience in the electrical business, and, like his father, whom everybody knows and esteems, his work is effective and profitable. Besides, the Phillips Insulated Wire Company is among the best in its particular line, and it is but natural that effective work should prove profitable.

Mr. C. C. Gartland, Buffalo, N. Y., exhibited an arc dynamo regulator as applied to Brush arc dynamos Nos. 8, 9 and 10. The regulator is power-actuated by some mechanical connection with the dynamo shaft, and moves the brushes and rheostat of the well-known Brush machines. The actuating device consists of but a single coil, and rotation of the brush and resistance arm in either direction is produced by a double pawl and ratchet arrangement. The regulator was very closely examined, and seemed to meet with general approval.

Messrs. Arthur Wright and Henry Reason, of Brighton, England, and William Leonard Madgen, of London, were kept extremely busy in describing the various features involved in the Wright demand meter, which was exhibited by them. This meter is a most simple mechanism, whereby it is possible by direct indication to ascertain the exact amount of maximum consumption of each particular current service, and from this base a price for current, depending upon the maximum consumption instead of the aggregate consumption.

Among the exhibits of electrical apparatus, the display made by the Westinghouse Electric & Manufacturing Company undoubtedly attracted the greatest attention. It was generally commented upon by the guests and delegates that the exhibit made by the Westinghouse Company was not only very complete, but was full of interesting features. Several lines of apparatus were in view and in actual operation. Among them was a 15-hp 500-volt direct-current motor driving a 7½-hp 125-volt direct-current generator, and a 10-hp 100-volt alternate-current direct-current two-phase generator. From the alternate-current circuits were operated a 1-hp two-phase induction motor, constant-potential arc lamps, induction motors, etc.

The Sawyer-Man Lamp Company, of Allegheny, Pa., had a very attractive exhibit in conection with the Westinghouse display, consisting of lamps of various candle-power and voltage. The principal feature of this exhibit was the display of 220-volt lamps. The very long filament necessary for a thoroughly satisfactory lamp of this high voltage is rendered perfectly stable by means of the three-point support for the loop, making impossible the short circuiting of the carbon, due to vibration or jarring. Attention was also called to the glass bridge between the leading-in-wires which serve as a support for the anchor, from the stem. It is a well-known fact that a 220-volt lamp, if made after the standard type, is liable to short circuit across the leading-in-wires, this device rendering impossible such short circuiting.

The Westinghouse Company was represented at the convention by the following gentlemen: C. F. Scott, Pittsburg; B. C. Lamme, Pittsburg; C. A. Bragg, Philadelphia; T. B. F. Pain, Boston; F. S. Smith, Pittsburg; Maurice Coster, Chicago; Paul T. Brady, Syracuse; T. C. Frenyear, Buffalo; C. F. Medbury, Chicago; F. N. Waterman, New York; W. K. Archbold, New York; H. P. Davis, Pittsburg; Clarence A. Ross, Buffalo; E. H. Heinrichs, Pittsburg, R. S. Feicht, Philadelphia; Arthur Hartwell, Pittsburg; C. S. Skinner, Pittsburg.

The Hope Electric Appliance Company, of Providence, R. I., made a great "hit" with its "make and break" switch exhibit, attracting universal attention, surprise and favorable comment. The eloquence of President Robert Fessenden, particularly the utterance that the magnificent specialties of the Hope Company represented "mechanical movement," their foundation principle was continuously on tap. The mature mind of Secretary John I. Drake, a pioneer in central station and electrical work, was also constantly evolving practical "nuggets" for meditation.

Habirshaw Wires and Cables were excellently represented by Dr. W. M. Habirshaw and Messrs. James W. Godfrey and Frank W. Harrington. Everybody knew these gentlemen. Whenever a skeptic was met who was befogged regarding the qualities of Habirshaw wires he was won over by the exhibition of their samples. The very unique little pocketbook they distributed was so greatly in demand that the supply soon gave out. Red, white and blue ribbons, combined with a Habirshaw button were distributed to an almost universal extent, and were also very much sought after.

Mr. Franklin S. Terry, vice-president of the Sunbeam Incandescent Lamp Company, of Chicago, was at the convention in the interest of the Sunbeam lamp. Somewhere, once upon a time, Mr. Terry got the name of "Sunshine" Terry, and those who know him will have little difficulty in understanding how this came about. The opportunities presented by the convention were not neglected by this gentleman, who left unturned no stone in the path of business. He reports very successful business for his company, and says that the Sunbeam lamp will lighten the darkness of many places during the ensuing months.

Thresher Dynamos and Motors were represented by Mr. Alfred Addison Thresher, president of the Thresher Electric Company, Dayton, Ohio. Mr. Thresher, although one of the younger men in the electrical fraternity, is already one of the best known. It is to his energies that the recent development made by his company in the direction of direct-connected motor work are particularly due. The success attained by these machines has been striking, and Mr. Thresher took pride in exhibiting a recent letter from a purchaser who found the Thresher direct-connected motor the machine he had long sought and mourned because he found it not.

The Bossert Electric Construction Company, of Utica, N. Y., was represented by Mr. W. F. Bossert, the inventor of most of the devices manufactured by the concern. Among the new things recently developed and which are particularly unique were a new electromagnetic circuit-breaker switch, steel drawn wall and outlet box, steel-armored and slate-lined junction box and various other switch and outlet boxes. The circuit breaker embodies many new features. The very excellent and novel switch construction, which has an instantaneous break, very accurately controlled by a simple electromagnetic trip device, is notable.

A Pass to a "Free Blow," signed P. A. Ragon, and countersigned W. Ind, was well distributed at the convention. The recipient, on visiting parlor 9 of the International Hotel, met the originator of this humorous invitation, Mr. J. P. Williams, of 39 Cortlandt Street, New York. The "blow" exhibit consisted of a large pyramid of Paragon fan motors, all in operation. Mr. Williams welcomed callers with an interesting introduction to the many excellent features of Paragon fan motors. In less than two hours after the exhibit was opened Mr. Williams was enabled to display a sign, saying: "This entire exhibit sold to the Chicago Edison Company."

The Belknap Motor Company, Portland, Me., sent Mr. Wm. H. Chapman, the inventor of the Chapman voltage regulator, manufactured by this concern. Mr. Chapman enthusiastically described the value of this device and exhibited several in actual operation. The regulator is intended to control the voltage of dynamos by an automatically-regulated field resistance. A notable feature is the practical elimination of sparking at the relay contacts controlling the rheostat-actuating coil. These voltage regulators, which are constructed for use on both direct and alternating-current machines, have been adopted by a large number of electric lighting and power stations.

THE WALKER COMPANY, of Cleveland, Ohio, was represented at the convention by a coterie of gentlemen, all of whom are well-known and of the highest standing in the electrical profession, Messrs. H. McL. Harding, of New York; A. F. Moore, of Pittsburg; J. H. Gates, of Chicago; W. A. Johnson, of Toronto, and A. V. Abbott, of Cleveland. The Walker apparatus is generally well known, but there were many points brought out by these gentlemen that had previously escaped notice. The new arc and alternating machines recently developed by the Walker Company were also prominently brought to the attention of the various delegates and the Walker parlor in the International was always filled with those eager to hear more about them.

THE EXHIBIT of the General Electric Company, at Niagara Falls, as compared with previous exhibits was small, but dealt with such apparatus as most nearly concerns managers of lighting stations. Briefly the exhibits covered were arc lighting, meter transformers, lightning arresters, and general appliances. The principal exhibit was a handsome board equipped with a type of every metering and measuring device manufactured by the company. The principal one was a large-capacity meter for measuring total station output of 2500 amperes and over. The meter specially built for the three-wire service of the Edison Electric Illuminating Companies was shown beside the power meter for meter service on 500-volt circuits, and the new street-car meters designed for attachment to street cars, to measure the consumption of current by the car, and to act as a check on the motorman.

The parlors of the General Electric Company were decorated with framed diplomas, and with some excellent enlarged photographs of its important installations and apparatus. Its representation included the following gentlemen: From Schenectady, N. Y., Prof. Elihu Thomson, S. Dana Greene, W. L. R. Greene, J. R. Lovejoy, H. C. Wirt, J. M. Andrews, J. W. Kirkland, G. DeB. Greene; J. H. L. Hilman. From Harrison, N. J., M. K. Eyre, A. D. Page. From Boston, Mass., Chas. W. Davis, A. R. Bush, F. M. Kimball, Caryl D. Haskins, S. S. Paine. From Lynn, Mass, W. D'A. Ryan. From New York, C. E. Estabrook, J. McGhie. From Philadelphia, H. J. Buddy, D. R. Bullen. From Baltimore, Md., J. P. Judge. From San Francisco, W. M. Ray. From Pittsburg, Pa., J. C. Galish. From Cincinnati, Ohio, L. H. Cooper, E. K. Gillette. From Syracuse, H. H. Crowell. From Columbus, Ohio, T. W. Dixon.

NON-ARCING FUSES were exhibited by the D. & W. Fuse Company. Providence, R. I. This fuse is of a radically new and novel design. It consists of a specially-tested lead fuse wire embedded in a casing of plaster compound. which is surrounded by a fibre cylinder capped at each end by the terminals of the fuse. Centrally between the two ends is a small cavity surrounding the fuse. Although these fuses are used for the highest potential, flashing is entirely eliminated, owing to the complete permeation of the casing with the volatilized metal. Furthermore, the adjustment is most accurate, the critical point being invariable. The inventor of this fuse, Mr. William C. Woodward, demonstrated these various points of merit, and distributed a souvenir fuse whose interior contained a cigar. Mr. Woodward is also the manager of the Providence Electric Light & Power Company.

MR. C. D. WILKINSON was in charge of the exhibit of the Western Electric Company, Chicago, New York, London, etc., which consisted of the latest fan motors brought out by this company. The propeller fan shown was of a rather new type, consisting of a horseshoe magnet field, which, complete with armature, made a most compact motor, whose power seemed entirely in excess of that to be expected from a motor of such small size. The efficiency, however, depends, as we are told by Mr. Wilkinson, upon the easy-running bearings and general excellence of design. In addition to these propeller fans, a very artistic combined column-blade fan and incandescent-lighting fixture, mounted in the centre of an ordinary circular table, was also shown. Both types of fan apparatus are particularly intended for use on direct current. In addition to Mr. Wilkinson, Messrs. Thomas G. Grier, of Chicago, Samuel Adams Chase and Edward Rockafellow, of New York, also represented the company. These gentlemen not only ably discussed the merits of the fans exhibited, but also brought out the many excellent features of Western Electric Company apparatus in general.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, of St. Louis, was very ably represented by Messrs. H. A. Wagner, A. H. Mustard, John Mustard, and Frederick Schwedtmann. These gentlemen took good care that the various new devices developed by the Wagner Company were brought to the attention of all of those interested. Among these new productions the single-phase alternating motor and alternating-current volt and ammeter are particularly prominent. The motor, which was shown in operation, consists of a multipolar field acting upon a multi-coil armature, the terminals of the coil being brought to a commutator. In starting the motor first operates as an ordinary series-commutated armature motor, but by the movement of a switch handle the after synchronism is attained, the armature commutator is short-circuited and the field coils disconnected therefrom, being left connected across the line, The indicating meter, which was shown in detail, is of a somewhat new type, involving the dynamometer principle. The notable feature, however, consists of a very efficient dead-beat arrangement, which makes this meter particularly available for central station and similar switchboard use. Switches, transformers and auxiliary appliances were also shown. A very elegant button, showing a photographic view of the Wagner works at St. Louis, was distributed.

"THE ELECTROTHERM heating pad, the electrical substitute for the hot water bottle," read a placard placed among the exhibit of the H. W. Johns Manufacturing Company, of New York. This apparatus which was exhibited, with many others, attracted a great deal of attention, which was also shared by the new electric car heater. The electrotherm, especially on account of its novelty, simplicity and cleanliness, and the opportunity it affords for maintaining indefinitely the temperature in making local applications of heat for the alleviation of human ills, attracted considerable attention. In addition to heating apparatus, the various asbesos specialties manufactured by the concern were shown. Particularly prominent, however, among the exhibits of the Johns Company were some new insulating devices. The new toggle clamp-cable insulator and the giant arc-lamp hanger were entirely new devices, and attracted a great deal of attention. Particularly notable among the special features embodied in both are their indestructibility of insulation and great strength. Samples of weatherproof sockets and of the Monarch and molded-mica compositions in a large variety of forms, vulcabeston regulator spools and other parts for arc lamps are only a few of the other appliances exhibited. Mr. W. F. D. Crane, of the New York office, represented the company at the convention, and had the exhibit in charge.

Among the others present may be mentioned Mr. H. L. Allen, of the Wyckoff Pipe Company, Williamsport, Pa.; E. H. Allen, of the Beacon Lamp Company, New Brunswick, N. J.; Messrs. L. M. Benine and J. S. Crider, of the Washington Carbon Company, Pittsburg, Pa.; Mr. M. J. Brayton, of the Utica Electric Manufacturing Company, Utica, N. Y.; Mr. W. J. Barrett, of the San Francisco office of the John A. Roebling's Sons Company; Messrs. D. D. Dickey and A. E. Carrier, of the Faraday Carbon Company, Jeannette, Pa.; Messrs. A. B. Crouse and S. B. Van Ranst, of the Crouse-Hinds Electric Company, Syracuse, N. Y.; Mr. Charles I. Hills, of New York, representing the Perkins Electrical Manufacturing Company, of Hartford, Conn.; Messrs. Lawrence, Urquhardt and Rice, of the National Carbon Company, Cleveland, Ohio; Mr. Herman Stearns, of the Stearns Electrical Engineering Company, New York; Mr. H. A. Tremaine, of the Crouse-Tremaine Carbon Company, Fostoria, Ohio; Mr. F. R. Upton, of the National Tube Works, McKeesport, Pa.; Mr. Wm. Wilson, of Milwaukee, Wis.; Mr. G. L. Wiley, of the Standard Underground Cable Company, New York; Mr. H. Adams, of Buffalo; Mr. C. D. Humphreys, of Pittsburg, representing the Heine Safety Boiler Company, of St. Louis, Mo.; Mr. W. J. Hastings, of the American Electric Company, of Detroit, Mich.; Mr. A. N. Harvey, of Chas. A. Schieren & Co., New York; Mr. J. B. Hubbell, of the Bryant Electric Company, Bridgeport, Conn.; Mr. W. A. Johnson, of Toronto; Mr. Herbert Lloyd, of the Electric Storage Battery Company, Philadelphia; Mr. R. E. Lucas, of the Indiana Rubber Insulated Wire Company; Mr. H. L. Livingston, of the Standard Thermometer & Electric Company, Peabody, Mass.; Mr. F. M. Laughlin, of the Solar Carbon & Manufacturing Company, Pittsburg; Mr. John W. Leach, of the Keystone Electrical Company, Erie, Pa.; Mr. H. A. May, of the Electrical Engineering & Supply Company, Syracuse, N. Y.; Mr. J. T. McRoy, of Chicago; Mr. T. W. Mercein, of the Northwestern Electrical Association; Mr. E. H. Peck, of the Phoenix Glass Company, New York; Messrs. F. S. Smith and C. E. Ross, of Allegheny, Pa., representing the Sawyer-Man Electric Company; and Mr. Hugo Reisinger, of New York.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Dynamos. MORDEY. Lond. *Elec.*, May 28.—The beginning of a reprint of an Institution paper. Admitting that the dynamo has excellent qualities, he states that these features are obtained at a high price and that there is plenty of room for improvement in reducing the lavish expenditure of materials; for instance 0.1 of the present exciting power would be amply sufficient to magnetize the iron, the other 0.9 being due to overcoming the armature reaction; the output should be limited by the heating rather than the sparking; the paper deals with the reduction of the material and labor by minimizing the sparking and armature reaction. Good dynamos may not spark, but the result is accomplished by expensive means; to show how small an air gap will suffice for mechanical purposes, he refers to polyphase motors, in which the armature reaction is essential to their success.; he examines the excitation data of several good dynamos, showing that over 99.3 per cent. is taken up in getting the magnetism through the rest of the circuit as distinguished from the armature core, where it is wanted. He compares toothed and smooth-core armatures, pointing out the advantages and disadvantages of each; in this connection he describes an experiment which illustrated the absence of eddy currents in conductors surrounded by iron and showed that in closed-circuit transformers it was not necessary to laminate the conductors; he shows that the toothed armature has everything in its favor except sparking and armature reaction. In discussing magnetic leakage he claims that it is a much more serious evil than is generally admitted; it averages about 30 per cent.; it appears a mistake to begin by magnetizing the field magnet when the real object is to get the armature core magnetized and then argues in favor of the iron-clad form; what is wanted is sparkless collection and small armature reaction with smooth cores, combined with the advantages and economy inherent in toothed armatures; he describes briefly the Sayers winding, in which the armature reaction is prevented by collecting in a position where the armature current assists the field; active coils are short circuited without sparking by means of auxiliary coils in the circuits of the commutator, which were idle except during the moment of commutation, when they generated a counter E. M. F. He then begins a very complete description of what appears to be a new system devised by him and consists in dividing each armature coil of a ring armature into two parts, separated some distance from each other, there being halves of similar coils located between the two halves of each coil; in a certain position such a coil would have two opposing E. M. Fs. generated in it and at that time it may be short circuited at the commutator although each is in a strong field; with this system there may be a saving of about half the ordinary field winding, while a further saving may arise from a possible lowering of the initial excitation; such a winding is quite symmetrical; within the space between the two halves of each coil the armature conductors carry currents which alternate in direction, so that there is no reaction from this part of the field; the armature reaction may be utilized for strengthening or weakening the effective field by compounding up in a dynamo or down in a motor; good results may be had with this arrangement with toothed cores; a 15 kw machine gave an output with good collection about one-third more than if it had been a smooth-core machine; the full-load excitation was only about 1 per cent. without an extravagant amount of copper; the reaction was so slight that it was impossible to tell from the brushes whether the full load was on or off, the brushes being fixed; it gave equally good results when used as a motor.

Armature Reaction and the Theory of Commutation. HAWKINS. Lond. *Elec.*, May 21.—A continuation of his long serial; he discusses on the same lines the rotation of the full current inductors which produce a decrease of the total field and of the displacement; also the rotation of the short circuited loops and the storage of energy by commutation. In the issue of May 28 he continues the subject of sparking on the same basis; there should be a balance between the storage and liberation of energy; for sparkless commutation the voltage in the short-circuited loop should be exactly sufficient to drive the normal current through it; the total number of lines and their position should therefore be kept the same at the end of the short circuit as at the beginning; this is accompanied by diagrams and calculations; the effects of under commutation are discussed, as is also the subject of the alteration of the total lines.

Condensers for Motor Work.—Elek. Anz., May 16.—A brief abstract of a paper by Stern. By connecting the condensers to a single phase system a phase shifting of almost 90 per cent. was produced, and the motors run with the two-phase current thus produced ran precisely as though they were connected with the usual two-phase system; the condensers made by Ganz & Co. consist of paraffin paper and tinfoil, the whole immersed in a bath of petroleum; by a certain method, not described, they are made to resist high voltages; the energy which they consume is said to be exceedingly small; they are now constructed up to 10,000 watts and can stand voltages up to several thousand; they are connected in the primary winding of a condenser whose secondary is connected in series with the motor; it is intended to connect the condensers directly with the primary, thereby converting a single-phase into a two-phase system.

Novel Three-Phase Alternator. SHEPARDSON. *Year Book of Univ. Min., 1897.*—A brief illustrated description of a Thomson-Houston arc light dynamo, which was transformed by slight alterations at the commutator into a three-phase alternator for purposes of instruction; it is only necessary to connect the three coils to three sliding rings (the suggestion, however, is not "novel," as it was made many years ago). It was preferred to modify the regular commutator so that the machine can be changed easily from one form to the other; the details of these changes are described; the machine will also operate as a synchronous motor.

Multi-Functional Dynamo. SHEPARDSON. *Year Book of Univ. Min., 1897.*—A description of modifications made in an old Edison dynamo for purposes of instruction, enabling it to be converted into a one, two and three-phase alternator and otherwise adapted for experiments and tests; the mechanical construction of some of these attachments is described.

Test of a Single-Phase Tesla Motor. PLACE. *Rose Technic*, May.—The results, in the form of curves, of a test of a small induction fan motor, preceded by a brief elementary description of the motor; the curves give the efficiency, slip and power factor per brake watts; the maximum efficiency appears to be 90 per cent, the power current varies from 3.5 to 4.5 amperes, while the wattless current kept at about eight amperes.

Care of Electrical Machinery. BAXTER. *Power*, June.—An article of some length, showing why generators sometimes fail to start.

Direct Current Transformer. THORDARSON. *Elec. Rev.* and *Elec. Eng.*, June 2.—An abstract of the paper noticed in the *Digest* last week.

LIGHTS AND LIGHTING.

Coloring Arc Lights.—Elek. Anz., May 20.—Formulas for materials which when mixed with the carbon powder used for making the carbons will give various colored lights, when used for arc lighting; the success of the method is questioned editorially. In the next issue Walloch states that a number of years ago he used the material of which colored lights are made in the cores of carbons, but he found that they had no effect on the color of the arc; the carbons split and the chemicals melted and ran out.

Relative Economy of Different Systems of Lighting. DELAHAYE. *L'Eclairage Elec.*, May 15.—An abstract of an article in which he gives tabular data comparing the various systems of lighting; the cheapest is the Welsbach, followed very closely by the electric arc, then by gas burners, incandescent electric light being among the most expensive.

Application of Projectors for Examining the Bottom of the Sea.—L'Eclairage Elec., May 1.—A short paragraph stating that this system was used with great success in finding the fragments of a torpedo; the projector was suspended from a balloon at a height of about 300 ft.; the sea was about 60 ft. deep at that place; the experiments are to be continued.

Process of Renewing Lamps.—Elec. Rev., June 2.—A brief description of the method used by a company in Lynn. Only those which have retained their vacuum are used; an opening is made the size of a lead pencil, and through this the whole filament is withdrawn and a new one inserted, it being cemented with a material the composition of which is kept a secret.

POWER.

Transmission of Power.—Lond. *Elec.*, May 28.—A reprint of three short papers read before the Institution of Civil Engineers. The first was by Preece on the transmission of power by electricity; it is broad, general and somewhat elementary, containing nothing new; some data from existing plants are given; in comparison with the transportation of coal he states that if this costs $1.25 per ton for 100 miles, it is less than the interest on the capital required to be expended on the construction of the line for transmitting the power electrically; the advantages of electricity are pointed out. The second paper, by Ellington, is on the transmission of power by water; it is greatly in favor of hydraulic transmission; he claims that an efficiency of 75 per cent. can be realized over an area of 4 sq. miles served from one

station, but admits that this efficiency may drop to 25 per cent. and less, depending on the purposes for which the power is applied. The third is on the transmission of power, by Hopkinson; it refers broadly to the five methods of transmitting, calling attention to sim larities; for tunnelling he thinks that compressed air will be universally employed; the great advantage of electricity is its great flexibility; hydraulic transmission is a formidable rival and there are places where it will be permanently better; on warships electricity would be better. In the discussion Bramwell thought the cheapest of all was transmission by gas; Sprague spoke of the advantage of electricity for elevator service; Forbes said the real question was how far can electricity be conveyed so as to compete with other systems and not how far it can be transmitted; he gives the following as the total cost of transmitting a cheap water power electrically over long distances: 100 miles, $100; 200 miles, $220; 300 miles, $400; 400 miles, $650. Parsons believed that steam was more economical than electricity or cables for traction; E. Hopkinson called attention to the distribution as distinguished from the transmission of power, and to the cost and difficulties in the gearing between the high-speed dynamo and the slow speed of the average machine to be driven; this gear, together with the switching arrangements, often amounted to 50 per cent. of the cost of the motor. Preece's paper is also published in the Lond. *Elec. Rev.* and *Elec. Eng.*, May 28 A reprint of the paper, by Ellington, is also begun in the Lond. *Elec. Rev.*, May 28, and is published in full, with the discussion, in the Lond. *Elec. Eng.*, May 28. Hopkinson's paper is also published in the Lond. *Elec. Eng.*, May 28.

Engines.—Lond. *Elec.*, May 28.—Reprints in part and in full with the discussion, of a number of papers read before the Institution of Civil Engineers. The first is by Donkin on important questions in the economic working of steam engines and boilers; the second is on separate condensing plants by Davey; the third by Aspinwall on petroleum as steam engine fuel; the next by Dowson on gas for power purposes; in the next by Swinburne on "Should a Generating Plant Be Mounted on Springs?" he raises this question, arguing that all parts of the engine would be subjected to smaller stresses if the bed plate is free to move; there would be no vibration communicated to the ground; he tried the experiment on a small scale with success; Ewing in the discussion said there would be a tendency to set up very violent oscillations owing to the synchronizing of vibratory tendencies; the experiences of others were brought out in the discussion; the last is a brief abstract of a paper by Parsons on the application of steam turbines to dynamos and alternators; the advantages are summarized, among them being the smaller first cost of the plant, buildings, maintenance, attendance, reserve, etc.; turbines of 500 to 700 electrical horse-power have been constructed; at present about 30,000 horse-power is in use in England; in the discussion it is stated that the claims have been fully justified. Some of these papers are also reprinted, with the discussion, in the Lond. *Elec. Eng.*, including some illustrations in the paper by Parsons.

Experiments on Electrically Driven Ventilating Fans. WALKER. Lond. *Elec. Eng.*, May 28.—The conclusion of his recent paper (see *Digest*, May 29).

Electricity in the Modern Machine Shop. BELL. *Eng. Mag.*, June.—The first article of a series. He discusses the reasons determining the choice of electric motive power, giving an idea as to when it is and when it is not of advantage to use it and discussing the question of when it is best to group the machines or to use individual motors; he suggests a series of questions the answers to which would indicate how the power should be used; he gives some general rules to be used as a guide; long shafts for transmitting power should be abolished, as also quarter-turn drives; a group of well and steadily loaded machines is best driven by a single motor; machines requiring large and intermittent power are best driven by individual motors; machines having the same average and large maximum power can be grouped advantageously; machines driven through long intervening shafts should be supplied with individual motors. In large and scattered plants, experience shows that the net efficiency is about 65 to 70 per cent. from the indicated horse-power of the motor pulleys, and this is considerably better than can be obtained by any other means and far better than if individual engines are used; even in an old plant there are few cases in which the change would not pay a large return on the capital invested.

Electric Power Equipment for General Factory Purposes. JACKSON. *Amer. Mach.* and *Eng. News*, June 3.—An abstract of the paper read before the American Society of Mechanical Engineers. A list of 10 concerns is given, using over 500 horse-power of electric motors and 10 others of 100 horse-power; the relative costs and advantages of electrical and mechanical power distribution are discussed and the electrical system is shown to be much the preferable one for those using 100 horse-power or over; small lines of shafting and motors from 3 to 15 horse-power are recommended.

Electricity vs. Shafting in a Machine Shop. BENJAMIN. *Eng. News*, June 3.—A reprint of almost the entire paper read before the American Society of Mechanical Engineers; a synopsis is given in the *Amer. Mach.*, June 3. Tables are given showing the cost of operation and estimated savings under various conditions, and attention is called to the fact that efficiency of transmission is not the most important factor, the effect on the output of the product per man and per machine being the real criterion.

Rating Electric Power Plants. ALDRICH. *Amer. Mach.* and *Eng. News*, June 3.—An abstract of a recent paper read before the American Society of Mechanical Engineers. He argues that in a guarantee a definite output should be expressed in kilowatts (meaning kilowatt hours) per one million British thermal units supplied to the steam; he shows that this would be much better than the output per pound of coal; it then does not involve the boiler. The advantages are that it is a simple basis involving easily measured quantities; it applies to all plants operated by any kind of heat engine, and forms the most satisfactory basis for comparison; it forms a proper basis of agreements and guarantees. In the discussion, Porter endorsed the suggestion as a step in the right direction; Randolph suggests using the heat units of the coal.

St. Anthony Falls Power Plant.—St. Ry. Jour. and *Elec. Eng.*, June 2.—An illustrated description of this plant at Minneapolis, which is rapidly nearing completion and which is to be used for the railway connecting that city with St. Paul.

Telluride Power Plant. BLAINEY. *Cassier's Mag.*, June.—Under the heading of electrical power at high altitudes, he gives an illustrated description of this plant.

Rheinfelden. RATHENAU. *Cassier's Mag.*, June.—A condensed translation with a number of illustrations, of his long descriptive paper which was noticed in the *Digest*, July 25, 1896, see also Aug. 22.

Rathausen.—Eng. Mag., June.—An abstract of the description of this large water power plant, by Guinand, which was noticed in the *Digest*, April 3, under Lucerne (Installations).

TRACTION.

Roller Bearings for Traction. MARSHALL. Lond. *Elec.*, May 28.—A short paper read before the Institution of Civil Engineers, calling attention to roller bearings for journals of rolling stock and giving the results of careful experiments. The starting effort was 41.68 pounds per ton with the ordinary and 6.53 with the roller bearings; the running friction was tested by letting cars run down hill, and they traveled 111 and 320 feet respectively, the average frictional resistance being 84 and 9 pounds per ton respectively; in an actual practical case the saving was 23 per cent., in another 50 per cent., and in another and still lower grade 60 per cent.

Increasing the Adhesion of Wheels by Magnetism. MEYER. *Elek. Anz.*, May 13.—An illustrated article in which he studies the question of the alleged increase in adhesion produced by creating a magnetic field between the wheel and the track; also the Foucault currents induced, and he comes to the conclusion that the increase of adhesion of steam locomotives by this means is of no advantage.

Equilibrium System of Feeding Electric Railways. SPAGNOLETTI. Lond. *Elec.* and *Elec. Eng.*, May 28.—A reprint of a paper read before the Institution of Civil Engineers. He explains his system for long lines, say 100 miles; a generating station is connected at each end of the line, the generators being, therefore, in parallel, and intermediate stations if necessary. He claims that the potential on the line is practically the same, no matter where the car is located; the resistance of a conductor is the same throughout. (It is not clear what the novelty is, unless it is in the abandonment of sections and feeders.)

Underground Conduit System.—L'Elec., May 15.—A brief mention of the Megroz and Stork system, in which the wire is enclosed in a buried tube with contact points leading to the surface every three or four meters (it should therefore not be called a conduit system); these are connected with the circuit automatically when the car passes and charge a battery carried by the car; how this is done is not explained. The note is taken from the *Schweizerische Baugzeitung.*

Conduit System in Vienna.—Elek. Zeit, May 13.—A note stating that permission has been given to use the Lachmann system on a portion of the lines in Vienna. (The system has been referred to a number of times in these columns.)

Overhead-Line Construction. GERTEIS. *Elek. Zeit.*, May 13.—An abstract of a recent paper discussing the construction of lines for strong currents, including the poles, insulators, wire and protection.

Transportable Electric Railway.—Elek. Anz., May 2.—A brief illustrated description of a system made by a German company for laying a temporary track and overhead trolley wire, the construction of the parts being such that they may be quickly erected and dismantled.

Motor Traffic. SALOMONS. Lond. *Elec. Rev.*, May 28.—The beginning of a long abstract of the paper which was noticed in the *Digest*, last week.

Cost of Electric Energy for Railways in New York and Massachusetts.—St. Ry. Jour., June.—A table taken from the annual reports of the railroad commissioners of those States for nearly all of the street railway properties; the table gives the number of cars owned, the car mileage per year and the cost of the electric power per car mile and per passenger. Of the 19 companies operating less than 250,000 car miles, 4 are obtaining power at a cost of less than 2 cents per car mile, 6 between 2 and 3 cents, 5 between 3 and 4 cents, 1 between 4 and 5 cents, and 3 at more than 5 cents; of the 5 companies operating over 5,000,000 car miles per year, 1 obtains the power for less than 1 cent per car mile, 3 between 2 and 1 cents, and 1 between 2 and 3 cents; other similar figures are also given between these limits. The Brooklyn Heights Company has the cheapest power, 0.86 per car mile,

followed by the Binghamton with 0.94; the cost of power for the Massachusetts roads includes repairs and depreciation of the station plant, which is not the case for the New York roads.

Electric Traction for Steam Roads. Henry. *Elec. Eng.*, June 2.—A reprint of a report made by him showing the probable cost and saving in changing the Florence and Cripple Creek Railway from a steam line to an electric line; he claims that the change would result in a saving which is sufficient to pay a desirable interest; he intimates that to use a third rail system would involve a loss. He calculates the saving to be $229 a day, the cost being $250,000.

Electric Traction Under Steam Railway Conditions. Davis. *Eng. Mag.*, June.—An article supplementary to the one noticed in the *Digest*, May 15.—In his former article he assumed the greater charge of the electric system and in the present one he examines this assumption in detail, giving a critical comparison of the two systems of installation and operation.

N. Y., N. H. and H. Electric Railroad System. Heft. *St. Ry. Jour.*, June.—A long article in the form of a well-illustrated outline of what has been done by that company in the last three years in the substitution of electric traction for steam; it includes illustrated descriptions of the power house and details, including also the Hartford-New-Britain-Berlin installation; it also contains a large number of curves showing the speed, current, voltage and power consumption on the Nantasket Beach Line, which, it is claimed, are published for the first time.

Power House in Chicago.—Power, June.—A long illustrated description of the No. 2 power house of the Chicago City Railway, designed by Hill, and about which there has been so much controversy. He used simple non-condensing engines with rope transmission, claiming greater economy when the interest on the additional expense of the usual type of plant is added to the fuel bill; an estimate of the probable expenses per kilowatt hour with interest and depreciation is figured out to be 0.6358 cent, of which the interest and depreciation is nearly one-fourth. The design is discussed editorially in the same issue in connection with a report by a firm of Chicago engineers, who claim that a plant of the same capacity could have been installed in about one-third of the space and with 25 to 50 per cent. greater fuel economy, besides a greater saving in first cost of the land and buildings, which saving would have largely offset the increased cost of better machinery. The same subject is also discussed in a number of communications published in the *St. Ry. Jour.* for June.

Locomotive.—Elec. Eng., June 2.—A brief illustrated description of one designed for a mining company; it is to have a draw-bar pull at eight miles an hour of 4500 pounds and is to have two motors of 50 horse-power; the total rise in the line is nearly 1600 feet in less than eight miles.

Constructing Electric Railways. Chance. *West. Elec.*, June 5.—A short article giving hints and advice concerning the construction, chiefly of the roadbed, rails, etc.

Trolley Car Repairs. O'Mahony. *Elec. Eng.*, June 2.—A short article enumerating the "troubles" which are apt to be found on trolley cars and giving brief hints as to how some of these are to be repaired.

Electric Traction Development. Baylor. *Elec. Jour.*, May 15.—An abstract of the paper noticed in the *Digest*, April 24, May 1 and 8.

Methods of Testing Railway Motors. Porter. *St. Ry. Jour.*, June.—A brief illustrated description in a simple and practical form of some of the useful tests that are ordinarily used.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Finding Leaks in Three-Wire System. Krempelhuber. *Elek. Anz.*, April 29.—When there is no leakage the current in the neutral must be exactly equal to the difference of the currents in the outers; when there is a leak on the line this equality will be disturbed by the amount of the leakage current; an ampere meter or relay is so constructed that the currents pass through it in such a way that it will detect only the difference between what should and what does return through the neutral; that is, the leakage current; this may be combined with the annunciator to indicate a leak. To locate the fault these measurements are repeated at various points along the line; the larger the indicated leakage the nearer one is to the leak.

Circuit Breaker. Volta system. *L'Elec.*, May 15.—A well-illustrated description of a combined bi-polar switch and circuit breaker to take the place of a fuse. One of the advantages, besides overcoming the disadvantages of fuses, is that on short circuits the current does not exceed a certain limit before it is broken, as it is prevented from increasing suddenly, owing to the very large self-induction in the magnet coil; this magnet is so proportioned with respect to the large quantity of iron as to make the self-induction as large as possible; the current at which it should interrupt is regulated by means of a spring; it also embodies a double-pole switch, which, however, cannot be closed if the short circuit still exists.

Fuses. Hundhausen. *Elek. Zeit.*, May 13.—An abstract of a paper with a portion of the discussion, on the new Siemens and Halske system of fuses, which complies with the requirements of the rules of the German Union of Electricians.

Edison Station in New York. Lomas and Gunton. Lond. *Elec. Rev.*, May 28.—A long, well-illustrated description of the stations of the Edison Illuminating Company of New York.

Rumburg.—Zeit. f. Elek., May 15.—A long illustrated description of this small central station plant of about 200 horse-power, in which the three-wire system is used in conjunction with accumulators.

Manchester.—Lond. *Elec. Eng.*, May 28.—Operating data showing the progress of this station.

St. Pancras.—Lond. *Elec. Rev.*, May 21.—Extracts from the report of the working of this station during the year ending April.

Improvements in the Three-Wire System. Hibbard. *Year Book of Univ. Min., 1897.*—A good summary containing brief descriptions of the improvements in the three-wire system, chiefly in the generators, which have been published; it is accompanied by diagrammatic illustrations; the references to the published descriptions are all given, most of them being to The Electrical World.

WIRES, WIRING AND CONDUITS.

Virtual Resistance. Taylor. *Elec. Eng'ing*, May 15.—A long article discussing the skin effect of an alternating current. After explaining it at some length and giving a mechanical analogy, he deduces two simple formulas, the one for copper being that if the cross-section in circular mils is less than 25,700,000 divided by the frequency, then the virtual resistance is equal to the ohmic resistance; the corresponding formula for iron is 480,000 divided by the square root of the frequency; the cross-sections equal to these quotients appear to be those at which the skin effect commences; the formulas are approximate; he gives two other formulas which are much more complicated and give the value of the virtual resistances, a curious feature of which is that the square of the diameter does not appear in them; he gives curves of the virtual resistance factor for copper and iron, which show that the skin effect is of no importance in the usual power transmission. The loss of voltage due to a virtual increase of resistance is a real energy loss; theoretically the loss due to inductance is not an energy loss, but merely increases the cost of the plant; this, however, is not true, as practically it involves a loss of energy; if for instance the inductance reduced the power factor to 50 per cent., then double the current would have to be transmitted, and as the energy loss varies with the square of the current this loss is increased fourfold; doubling the cross-section reduces the resistance to one-half instead of one-quarter; long before the skin effect would become significant in any power transmission the impedance would be so great as to make it necessary to divide the circuits. He discusses the increase of resistance in the case of lightning conductors, assuming a frequency of half a million and shows that the skin effect would be very superficial; with such high frequencies iron rods are as good as copper, as the difference of resistance is of no account. In general the virtual increase of resistance in ordinary alternating current work is so slight that it may safely be left out of practical calculations.

Overhead Lines. Perrine. *Elec. Eng'ing*, May 15.—A long article on poles for overhead lines, giving formulas for calculating them, together with hints and information about them.

ELECTRO-PHYSICS AND MAGNETISM.

Temperature Corrections for Dielectric Resistance. Appleyard. Lond. *Elec. Rev.*, May 28.—In temperature corrections for the change of resistance of dielectrics the logarithmic law is usually assumed; he gives a curve of the results of tests with paraffin paper condensers and over it draws the calculated logarithmic curve, showing, even under the most favorable conditions, a discrepancy of 5 per cent. or more; he then suggests measuring the differences between these curves and inserting them in a table in the form of correcting divisors corresponding to each degree; such a table is given for a paraffin paper condenser; he suggests this as a simpler way of making the corrections.

Dielectric Resistance. Drude. *Proc. Lond. Phys. Soc.*, May; abstracted briefly from the *Wied. Ann.*, 57, p. 223.—He defines a certain quantity as the dielectric resistance and discusses various theorems from the point of view suggested by this definition.

Heat of the Spark. Kaufmann. *Wied. Ann.*, 60, p. 653; abstracted briefly in Lond. *Elec.*, May 28.—He measured the heat developed by the spark discharge with the aid of a differential thermometer with a spark gap in one of the bulbs. The only general conclusion given in the abstract is that when the potential varied the heat of the spark varied as its cube, while the total heat varied only as the square root of the potential; the heat developed between brass terminals is only about half that between zinc terminals.

Discharges; Static and Dynamic Explosive Potentials. Swingedauw. *L'Eclairage Elec.*, May 8 and 15.—The beginning of a long thesis describing researches with sparking discharges. It appears to be a more elaborate paper on the same subject as the one noticed in the *Digest*, Jan. 30, where some of the principal conclusions were given.

Röntgen Rays. Levy. *Elek. Anz.*, April 25.—A very brief abstract of a recent paper describing how the time of exposure may be greatly reduced, The General Electric Company of Berlin has succeeded in reducing the time to 1-25 (of what, is not stated). This is accomplished partly by such high evacuation that the platinum can become very hot without damage; this increases the radiation about threefold; fluorescent plates are used in connection with the photographic plates and this reduces the exposure to one-fourth or one-fifth; the greatest improvement is in the construction of dry plates (not described) rendering them from two to four times more sensitive; a photograph of the human chest was made in 30 seconds.

Unipolar Röntgen Tubes. PFLUEGER. *Wied. Ann.*, 60, p. 768; noticed briefly in the Lond. *Elec.*, May 28.—He found some striking differences between the behavior of the two poles of a Tesla transformer, the discharge from one being much more intense than from the other; Röntgen ray tubes may be constructed with only one electrode, giving good results without the usual risks.

Absorption of Röntgen Rays by Crystallized Material. AGAFONOFF. *L'Eclairage Elec.*, May 8; an abstract of an Academy paper giving the results of quantitative experiments on the order of transparency of numerous crystals which he arranges in five groups; the abstract gives the names coming under these groups.

Loss of Electricity by Uranium Rays. BECQUEREL. *L'Eclairage Elec.*, May 15—A brief extract of a Physical Society paper in which he describes experiments made with a vacuum, in which he found that no effect was produced in vacua, the loss of charge being approximately inversely proportional to the square root of the pressure.

Electric Radiations from the Sun. DE HEEN. *Proc. Lond. Phys. Soc.*, May; noticed briefly from the *Comptes Rendus*, 124, p. 459.—The atmosphere of the sun appears to be a source of electric and infra-electric radiations.

Contact Electricity of Metals. LORD KELVIN. Lond. *Elec.*, *Elec. Rev.* and *Elec. Eng.*, May 28.—A brief notice of a Royal Institution lecture; it was a vindication of Volta's hypothesis of contact electrification; the rival theories, namely, that it was due to moisture or to the action of the air, were shown to be wrong and directly opposite to the truth, since air and moisture tend to destroy the electrification which simple contact produces; nevertheless, contact electrification is due to chemical action at a distance.

The Electric Medium. LARMOR. Lond. *Elec.*, May 28.—A brief abstract of a Royal Society paper; it is theoretical in character and concerns the relations with material media, touching upon the points where Maxwell's and Helmholtz's theories require completion; the main idea of the paper is a criticism of the prevalent view of step-by-step or contact transmission and the formulation of a kind of action-at-a-distance theory, in which the electrodes take the part of strained centres.

Theory of Electricity. VASCHY. *Proc. Lona. Phys. Soc.*, May.—A very long abstract of the mathematical paper noticed in the *Digest*, May 9, 1896, and containing an outline of an electrical theory based primarily on the properties of an electric field in a medium.

Resistance of Liquids in Motion. BOSI. *Nuovo Cimento*, April; abstracted briefly in Lond. *Elec.*, May 21.—He measured the electrical resistance of liquids in motion by a new method and found a small change due to the motion, the change depending on the substance dissolved; in solutions which do not undergo concentration at either pole there is no change in resistance.

Electromagnetic Equations. VASCHY. *Proc. Lond. Phys. Soc.*, May; abstracted at some length from the *Comptes Rendus*, 124, p. 226; a paper of a highly mathematical nature.

Theory of Stationary Waves. DRUDE. *L'Eclairage Elec.*, May 15.—A very long abstract of a mathematical article from the *Wied. Ann.*, 60, p. 1.

Partial Polarization of Luminous Radiations Under the Influence of the Magnetic Field. EGOROFF and GEORGIEWSKY. *L'Ind. Elec*, May 10.—A reprint of an Academy note. They repeated the experiments of Zeeman, making their observations of the partial polarization direct.

Magnetic Molecules. KLINGENBERG. Lond. *Elec.*, May 28.—A brief abstract of a thesis involving suggestions as to the shape of the molecules of iron and nickel, to account for the change of length upon magnetization; he supposes those of iron to be ellipsoids of revolution, some prolate and others oblate, their magnetic axes coinciding with their axes of revolution; nickel would consist of oblate spheroids only.

Permanent Magnets. KLEMENCIC. *Proc. Lond. Phys. Soc.*, May; abstracted briefly from the *Wien. Ber.*, 105, p. 635.—A report of experiments on the permanence of tungsten steel. Repeated reversals seem of great benefit in establishing a steady final magnetization; this steel is not greatly affected by moderate blows, but it is very important to keep the magnets away from the influence of magnetic disturbances, and he therefore suggests sealing the magnets in glass tubes to avoid contact with other magnets.

Tortion of Nickel. CANTONE. *Nuovo Cimento*, April; noticed briefly in the Lond. *Elec.*, May 21.—An article which appears to be the conclusion of the description of his extended researches with the magneto-electric properties of nickel; he has collected a large number of experimental data of value for developing a theory.

Magnetic Current. BRAUN. *L'Eclairage Elec.*, May 8; abstracted from the *Wied. Ann.*, 59, p. 693.—A longer abstract of the paper noticed in the *Digest*, May 6.

ELECTRO-CHEMISTRY AND BATTERIES.

Iron Chloride Battery. RAMMELSBERG. *Elek. Anz.*, April 15.—A short article in defence of this much-abused battery, which was first suggested in 1862; by using a carbon instead of a copper plate he has made this cell quite useful; he thinks the cost of working, for such a cell, especially in view of a possible and probable cheap method of regenerating the electrolyte, would not be so great that it could not be used to advantage in many cases, especially where the cost is not of prime importance; he prefers the horizontal arrangement of the electrodes. He gives the following figures for a cell (dimensions not given); at 2 amperes the voltage for iron was 0.7 to 0.8, and for amalgamated zinc 1.1 to 1.2, both remaining constant until the electrolyte is exhausted, which takes about 6 hours for one liter (1.1 quarts) of concentrated solution; by the addition of some salt and water the current was continued for months.

Carbons for Electrolytic Purposes.—Lond. *Elec.*, May 28.—The results of a test, which was made for that journal, of the carbon mentioned by Lessing, which was noticed in the *Digest*, Feb. 13 (see also Feb. 27); the report by Messrs. Stanger and Blount is published; in this it is compared with Irex and with retort carbon. The amount of ash in Lessing's carbon was considerably greater, as was also the loss of weight in fused nitre; when subjected to an attack by electrolysis it corroded considerably, while the others were evenly attacked; they arrive at the opinion that the best is the retort carbon, closely followed by the Irex, the Lessing being inferior to both of them.

Gravitational Cells. DESCONDRES. *Proc. Lond. Phys. Soc.*, May; abstracted from the *Wied. Ann.*, 57, p. 232.—He describes experiments to determine the E. M. F. of the Colley cell, showing the differences in the E. M. F. when the current is up and when it is down through the cell.

Phase Difference Caused by an Electrolytic Cell. MALAGOLI. *Proc. Lond. Phys. Soc.*, May; noticed from the *Nuovo Cimento*, 4, p 296.—A theoretical paper on the displacement caused by a voltmeter in an alternating current; the paper is said to be polemical.

Depolarization of Platinum and Mercury Anodes. MEYER and KLEIN. *Jour. Inst. Elec. Eng.*, May.—The conclusions of an article in the *Beiblaetter*, 2, p. 137.

Densities and Conductivities of Electrolytes. LOOMIS. *Proc. Lond. Phys. Soc.*, May; from the *Wied. Ann.*, 60, p. 547.—He determined these properties for very pure solutions and for which these values were doubtful; a table of results is given in the abstract.

Electric Purification of Sugars. URBAIN. *Rev. Gen. des Sciences*, May 15.—He favors the use of electricity, believing it has a great future and describes the Jin and Leleux, and the Javaux, Gallois and Dupont system.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Comparison of Resistance Standards. LINDECK. *Jour. Inst. Elec. Eng.*, May; abstracted briefly from the *Beiblaetter*, 3, p. 240.—He compared the standard resistance of the Reichsanstalt with those of the British Association, and found that one legal ohm equals 1.01063 B. A. unit and one international ohm equals 1.01349 B. A. unit; Glazebrook found that one legal ohm equals 1.01061 B. A. unit.

Dimensions of Electric and Magnetic Quantities. JOUBIN. *Proc. Lond. Phys. Soc.*, May, and *Jour. Inst. Elec. Eng.*, May; abstracted briefly from the *Jour. de Physique*, Feb.—He shows that the dimensions can be completely determined as a function of the fundamental units or rational mechanics by admitting a postulate; he shows that the formulas arrived at by this means are exact without any restrictions. (See also *Digest*, Nov. 7.)

Measurements with High Frequencies. SMALE. Lond. *Elec.*, May 28.—A brief abstract of a paper from the *Wied. Ann.*, 60, p. 625. His electrometer method may be used for frequencies up to 10 million; two electrometers with quartz fibres were mounted in parallel, one charged with water and the other with a salt solution; the ratio of the deflections was therefore fairly constant; his results showed that the dielectric constants of good liquid conductors increase with the concentration, but not in proportion to the conductivity.

Measuring the Resistance of a Human Body. HEDLEY. Lond. *Elec. Rev.*, May 28.—A reply to the criticism noticed in the *Digest* last week and calling attention to the variations in the component parts of the human body, with reference to the resistance; he believes his method will give the mean resistance. It is followed by a reply by the critic in which he maintains that Hedley's method does not give the desired result but that the critic's method will give the best approximation.

Large Wimshurst Machine.—Lond. *Engineering*, May 21.—An illustrated description of the largest one seen in London; there are 12 plates 36 inches in diameter, each having 32 sectors; the length of spark is 32 inches.

Condensers. WULF. *Proc. Lond. Phys. Soc.*, May.—An abstract of what appears to be the same paper as was noticed in the *Digest*, May 29, under Electro-Physics.

Universal Galvanometer.—Elek. Anz., May 16.—An illustrated description of the new Siemens form, with illustrations of various applications to which it may be put.

Platinum Standard. VIOLLE. *Prog. Age*, June 1.—A reprint of a brief paper read before the International Society of Electricians in Paris. He describes recent experiments with his well-known unit of light, showing that it is not as impractical as has often been stated; it is necessary to have the platinum pure. He melted it in a furnace of quicklime with an oxyhydrogen flame; the work requires care, but nothing more, not even exceptional dexterity; it is in the original material rather than in its use that difficulties are met with; only absolutely pure platinum should be

used and only good lime; chloride of ammonia will generally clear the surface of the platinum; when it does not clear itself readily the platinum must be purified chemically; with these precautions a standard is obtained which is constant and invariable, and with which a lamp can be standardized by an easy operation, although the reading must be made instantaneously, since the time marking the moment of solidification is extremely short though clearly defined; fusions may be made at the rate of 10 to 20 per hour; if the lamp is uniform, remarkably concordant results will be obtained; he obtained a precision three or four times greater than the one-sixtieth, which was formerly regarded as the greatest accuracy.

Convenient Ammeter Plug Board. Shepardson. *Year Book Univ. Min.*, 1897.—A brief illustrated description of a device to be attached to a station ammeter of the Weston type, adapting it to the measurement of currents of different intensities and generated in different localities. The instrument is simply attached to a plug box, the blocks of which are connected to the ends of differently graded shunts or connected with wires to shunts located in different places in the building. (Another and simpler method is to unplug resistances in the galvanometer circuit, using only one shunt, and it then becomes the well-known Munich method, used so largely in 1882; it involves a longer shunt, that is, one of greater resistance.)

Lehigh University.—Elec. Eng., June 2.—A brief illustrated description of the electrical laboratory. (A daily newspaper states that Prof. Wm. S. Franklin, of the Ohio State University, has been elected professor of physics and electrical engineering at this university, to succeed Professor Harding.) The present development of this course is due to Dr. Macfarlane.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Disturbance of Submarine Cable Working by Electric Railways. Trotter. Lond. *Elec.*, May 14, Lond. *Elec. Rev.* and *Elec. Eng.*, May 21 and 28.—A reprint, with numerous illustrations, of an Institution paper. After the opening of an electric railway at Cape Town it was found that the working of the siphon recorder was seriously disturbed, the reading being rendered unintelligible. He shows, with the aid of records, the nature of these disturbances, which were largely in the form of kicks, and then describes at considerable length a large number of tests of various kinds which were made to find the cause, and a remedy for the trouble; there was a marked difference between the kicks produced on the telephone line and on the cable; all the methods tried were unsuccessful except the last, which was entirely successful, and consisted of a new earth plate formed of a cable about five knots long laid out into the sea as nearly as possible over the old one, the distant end of this cable being connected with its outer covering, thus making it an earth plate out in the sea; since this was done no appreciable disturbances have been noticed. The Lond. *Elec.* and *Elec. Eng.*, May 28, contain a reprint of the discussion. Bright praised the paper because it also gave the results of unsuccessful experiments, which feature is rarely found in papers; Luke described a case at Madras, where it had been found that nothing overcame the difficulty until a highly insulated line was run from the telegraph office to the cable house and connected with the guards of the cable, making the end circuit a metallic loop; the earth line was taken as far out to sea as possible and terminated in a copper plate; Gadsby spoke of some experiments at Madras, and thinks he determined that the interference with telephone was due to induction, while for submarine cables it was due to leakage; the difficulties have not quite been overcome by the device mentioned by Luke; he suggested that disturbances were not directly due to either leakage or induction, but to the condenser effects of the earth; Ayrton said that this was simply another way of expressing leakage; he described a magnetic survey made four years ago in the neighborhood of his laboratory, in which the effects on the magnetic needle was measured, and there was therefore no question of leakage; he believes that the use of an insulated return would be of benefit to the electric railway companies.

Rapid Cable Laying for War Purposes. Crutchley and Snell. Lond. *Elec. Rev.*, May 28.—A continuation of the well-illustrated reprint of their recent paper. The Lond. *Elec.*, May 28, contains a reply by Snell to the editorial criticisms of this system; it is followed by another editorial reply.

Submarine Telegraphy. Wingfield. Lond. *Engineering*, April 23.—A communication in which he describes, with the aid of illustrations, certain interesting mechanical analogies which were made by Ayrton in his recent lecture on Sixty Years of Submarine Telegraphy; (some of the analogies were contained in former references to this lecture).

Repairs of Submarine Cables. Benest. *Jour. Inst. Elec. Eng.*, May.—A reprint in full, with the very long discussion, which was noticed in the *Digest*, April 3 and 24.

Bells without Iron.—Elek. Anz., April 29.—A note stating that in certain damp, exposed localities where iron could not be used, the cores were made of nickel, the magnetization of which was enough to operate the magnets; this metal was not attacked and the bells, which formerly were rendered inoperative in four weeks, have now run four months without any signs of being affected by the weather.

Telephone Meters.—Elek. Anz., May 20.—A brief summary of descriptions of a number of different forms which have been proposed.

Railway Switches and Signals.—Elek. Anz., April 25.—A well-illustrated description of the Siemens and Halske system.

Telegraph and Telephone Statistics for Germany.—L'Eclairage Elec., May 8.—A brief abstract from the German report.

Telephony.—Elec. Eng'ing, June 1.—A number of short articles; one an address by Tyler on the history of telephone service, another a report by Marigold on the reduction in rents of telephones, and another on a costly experiment with a telephone plant at Somerville, N. J.

Berliner Patents.—Elec. Rev., June 2.—A reprint of the complete patent specifications of his two patents.

Cost of Constructing, Operating and Maintaining a Telephone Plant.—Elec. Eng'ing, May 15.—An extract from a report made for a Bell station of 2,447 subscribers; the investment was half a million and the net income $37,652, corresponding to a dividend of 7.53 per cent.

Automatic Morse System. Teleg. Age, June 1.—A brief illustrated description of the Weiny-Phillips system, in which the tape is embossed.

MISCELLANEOUS.

Continuous Currents Through Organic Tissues. Weiss. *Jour. Inst. Elec. Eng*, May; abstracted from the *Jour. de Physique*, Feb.—He shows that continuous currents of sufficient strength passing through muscles for a sufficiently long time produce marked lesions visible in the microscope; they are accompanied by polarization phenomena; he compares a muscle to a mass of particles which polarize, thus acting as small accumulators; if his hypothesis is correct his results constitute the first experimental demonstration of Grotthus's hypothesis.

Gas Lighting from a Distance.—L'Elec., May 8.—An illustrated description of a system applicable to a large number of lamps; it appears to be based on the use of a small auxiliary flame which remains lit all the time, electricity being merely used to turn on the gas.

Globe Lightning. Hagenau. *Pop. Science Mo.*, June.—A translation of a short article from the German, giving descriptions of well-attested recent cases in which this peculiar form of lightning was observed; the witnesses were so numerous and the records so trustworthy, that the existence of this form of lightning must be admitted. Its nature is not yet understood, although a similar effect on a small scale was produced artificially by Planté and others; the theory has been suggested that the fire balls consist of heated air and water vapor, but this theory is insufficient and does not explain all the observed facts; much benefit could be derived by the proper recording of observations and he suggests that all witnesses of the phenomenon should send a copy of their observations to one of the meteorological journals.

Electric Furnace. Lelievre system. *Elec. Eng.*, June 2.—A brief illustrated description; it is intended chiefly for continuous action and to attain the best utilization of the heat. The furnace consists of a vertical cylinder of fire-brick at the bottom of which the material passes through the arc, formed of multiple electrodes; the gas liberated is burned under the material to be charged, whereby the heat is utilized.

Direct Conversion of Heat into Electricity. Cox. *Elec. Rev.*, June 2.—The beginning of a reprint of his recent New York Electrical Society paper, which was abstracted briefly in The Electrical World, May 29. An abstract, with the discussions, is published in the *Elec. Eng.*, June 2.

Foresight in Electrical Engineering. Woodbridge. *Cassier's Mag.*, June.—A short article urging electrical engineers to avoid conservatism; they should be not only up to date but even ahead of date if possible; he compares American with European practice, the two extremes; in Europe every effort is made to obtain durability and reliability regardless of first cost; he thinks that rapid advances will be prevented by conservatism in Europe, but for the present Americans have more to copy than to be copied.

Epoch Making Events in Electricity. Stockbridge. *Eng. Mag.*, June.—The third of his series of articles; it is on Arago and the beginnings of magneto-electricity. As these articles are of a historical nature, they will not again be referred to in these columns.

Biographical.—Teleg. Age, June 1.—A brief biographical sketch, with portrait, of Ralph W. Pope.

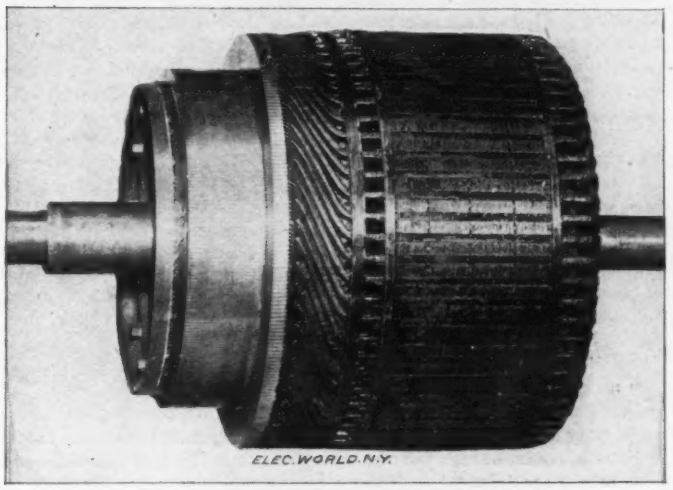
Duty on Mica.

The tariff on mica is engaging the lively attention of those interested, and a vigorous campaign against the proposed increase of duty on this useful mineral is in progress. The present duty on mica is 20 per cent. *ad valorem*, and through the representations made by the opponents of what is thought to be an unreasonable duty, the Committee on Finance reported to the Senate an amendment to the new tariff bill providing for 40 per cent. *ad valorem*, or double the present duty. Other amendments have been offered, which have for their object considerable increase in the duty. The fact that the soft mica best suited for electrical work is not produced in this country, would seem to render any great increase in the duty unwise, as it would entail an unnecessary hardship upon the manufacturers of electrical apparatus, while affording no benefit to the American mica industry. Messrs. Eugene Munsell & Co., New York, in a circular letter urge all interested to write strong letters to their Senators in favor of securing a rate nearer the present duty, or to support the amendment of the Finance Committee, which is the least objectio nable of the propositions made.

Slow Speed Generators and Motors.

The relative value of different speed generators and motors is a question that is governed by special considerations and can be only decided with a full knowledge of the purposes for which the apparatus is required. As in other power machinery, the higher the speed the lighter the different parts and the lower the cost of construction; with the slower speed, the wear and tear is obviously decreased and the life of the various parts subjected to wear correspondingly lengthened.

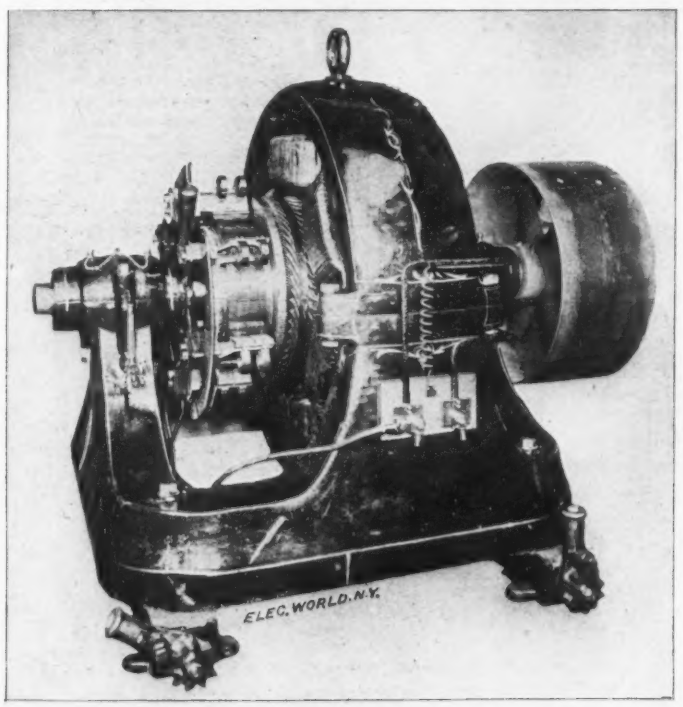
The Triumph Electric Company, Cincinnati, Ohio, is building a line of



ARMATURE OF RAILWAY GENERATOR.

slow and moderate speed machines, giving each the same careful attention as regards design and construction.

The illustrations herewith represent one of the company's 150-kw belted railway generators and the armature of the same. The armature is bar-wound, each bar being thoroughly insulated with mica, and so brought out and protected at the heads as to render a burn-out almost impossible. The machine is of the six-pole type, with laminated wrought-iron poles and armature. The laminations of the armature are punched to allow a



150-KW BELTED RAILWAY GENERATOR.

clear passage for ventilation through the armature and commutator, the construction, however, being such as to prevent the collection of dust on any conductor.

The commutator is large and constructed of the very best copper, the insulation being pure mica. The construction is such that it is impossible for the segments to move or be subjected to any other strain than direct pressure.

All parts of the machine are subjected to test with an alternating current for insulation resistance, and the completed machines are severely tested under actual working conditions of load and overload before shipment.

The low temperature limit and the high efficiency of the Triumph Company's apparatus are, it is stated, appreciated by leading engineers.

The frames of the Triumph Company's machines are made in one casting in the sizes up to and including 20 kw; above this size they are parted horizontally to facilitate the removal of the armature or field coils. The field frame is made of soft, close-grained cast iron, the pole pieces of thin sheet iron cast into the field. In machines above 20 kw the pedestals are cast solid with the base; below that size they are cast separately and bolted to it, allowing of their removal when it is desired to take out the armature. The bearings are phosphor bronze, of the ball-socket type, and provided with ring oiling and self-aligning devices.

The Triumph Electric Company produces a large line of electrical machinery, including direct-connected apparatus, street railway generators, marine generating sets, elevator motors, etc. It also makes a line of bipolar motors designed to meet the demand for a good low-priced machine. These machines are entirely encased and protected, and their construction is both durable and compact, and the same care is bestowed upon them as upon the apparatus above described.

The company gives very careful attention to the design of motors for special purposes, and with its large facilities it is able to produce the best results.

A Steam Saver.

The device illustrated herewith, which is known as the Heintz Steam Saver, has been recently introduced in this country with very satisfactory results. Its object is the economy of steam and consequent saving of fuel, and it is very largely used abroad, where it is said to be giving the best of

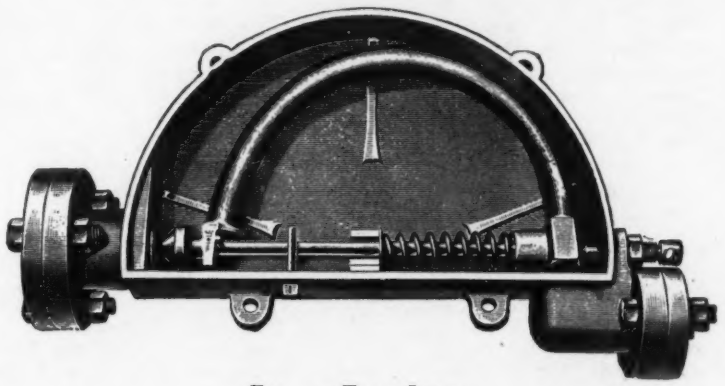


FIG. 1.—TRAP OPEN.

satisfaction in practice. It is a simple device, and a brief description of its operation will be of interest.

The tube spring which is shown in the open trap, Fig. 1, is partly filled with a fluid that is quickly acted upon by heat, and as soon as the temperature of the passing water reaches 197 degrees, this fluid has expanded to full volume and completely fills the tube spring. As the temperature keeps on rising the liquid expands the ends of the tube spring until at 212 degrees the disc has been forced into the seat and the valve is shut tight against any pressure up to 200 pounds. In this form of trap no steam is consumed in its operation. It makes no difference what the boiler pressure is, the trap closes when steam comes. The manufacturers claim for the device a lifetime of usefulness. It occupies little space and can be placed

FIG. 2.—TRAP.

in any position, no special provisions for its installation being necessary. It cannot freeze nor choke and needs no valve to carry off the air, which passes off with the water, the valve not closing until all has been eliminated.

During the past fifteen or sixteen years a uniform saving of fuel has resulted from the use of these traps, this saving averaging about 20 per cent., although in this country as high as 33 per cent. has been shown.

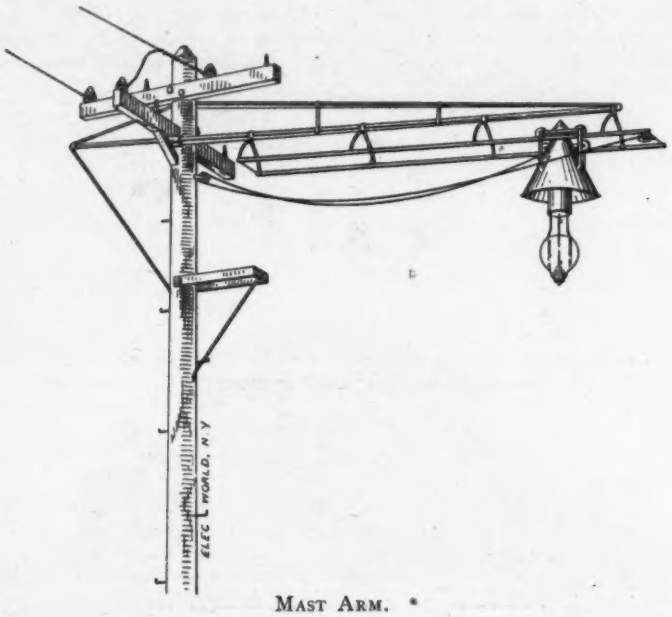
Mr. William S. Haines, Philadelphia, Pa., who is the American manufacturer of this trap, has in his possession a large number of letters testifying to the excellent results obtained by the use of the Heintz steam traps.

Among these letters is one from the superintendent of the Union Traction Company, Philadelphia, who states that these traps are giving entire satisfaction in the power houses of the company, and he heartily recommends them. They are in use in many other power plants other than electric power stations, and giving uniformly good results.

Fig. 2 shows the device in perspective, while Fig. 1 gives a view of the interior mechanism, the simplicity of which is one of its most striking features.

A Mast Arm.

Among the various mast arms or devices for supporting arc lamps used for public street lighting that of Messrs. C. W. Walls & Co., Worcester, Mass., merits especial attention. This device has been in satisfactory use or some time by the Worcester (Mass.) Electric Light Company, which



Mast Arm.

adopted it after having experimented with various other devices. This company is now using over 100 of them on its lines, which fact should abundantly emphasize its value.

The device, though simple in operation, is rigid and secure when in position. As shown in the accompanying illustration a wrought-iron gas pipe, strengthened by a truss above to relieve the weight from the horizontal plane, is attached to the pole and held at the further end by an under support which acts as a brace below. This wrought-iron pipe holds, by means of supports, the small track on which the hoods and four wheels are drawn in and out. The lamp is held stationary when in position, thus avoiding any short circuiting on the line.

The convenience of the arrangement of the mast arm will readily commend itself to central-station managers.

Store Window Lighting.

It is stated that ninety-nine store windows out of every hundred are imperfectly lighted, especially where electric lamps are used. As a rule, the

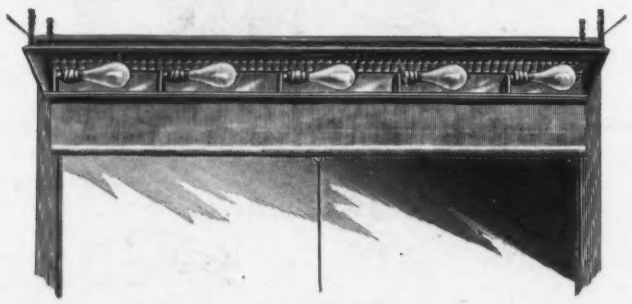


Fig. 1.—Window Reflector.

lamps are scattered at the bottom and sides of the windows where they can be seen by lookers-in, thus attracting more attention to themselves than to the goods which they are intended to light. The ideal window light should throw the light on the goods, and the source of the light should be completely obscured from the eyes.

The special window reflector illustrated herewith, made by I. P. Frink, New York, is designed to accomplish these results. These reflectors are arranged for electric light and lined with silver-plated corrugated glass. They are placed at the top of the window near the front glass, reflecting the light inward and downward, and they make a very desirable window reflector, as they are put up out of the way and concealed from view. They give a strong and even light where wanted, thus avoiding the annoyance of a dazzling light in the eyes.

One of the illustrations (Fig. 1) shows a front view of the lights and reflectors in place, and Fig. 2 is a cross-sectional view showing the method of suspending the lights. In Fig. 3 the arrangement is somewhat different, in order to meet the peculiar requirements of some forms of windows. The reflectors in this case are suspended from a bracket as shown, while those illustrated in Figs. 1 and 2 are suspended from the ceiling.

These reflectors are claimed to be the best window lights made, and they have been adopted by leading stores in the principal cities of the United States. They are also largely used for lighting art galleries, pictures, stock-exchange boards, border lights, telephone switchboards, etc., and innumerable other applications of the device are obvious.

A New Two-Point Switchboard.

A telephone exchange switchboard that possesses considerable merit has just been brought out by Mr. Sterling L. Bailey, Rialto Building, Chicago. The board, which is illustrated herewith, is of the two-point type, that is to say, when a subscriber calls the central station the operator "plugs in" to the calling number and presses a flexible and movable jack to the right, which places the operator in communication with the subscriber. On ascertaining the number desired by the subscriber, the operator "plugs in" that number and moves the flexible jack to the right, this placing the two subscribers in communication one with the other. These connections are made with one movement after the plug has been inserted in the jack. To "listen in" the operator presses the flexible jack to the left with the plug.

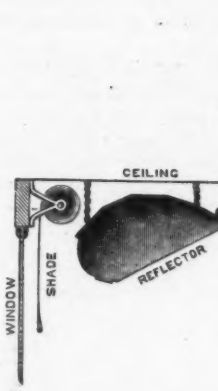


Fig. 2.—Ceiling Suspension.

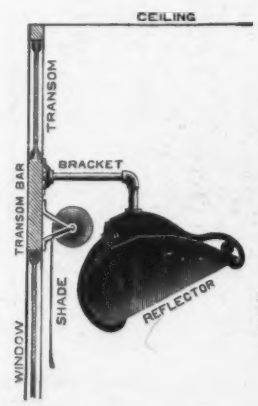
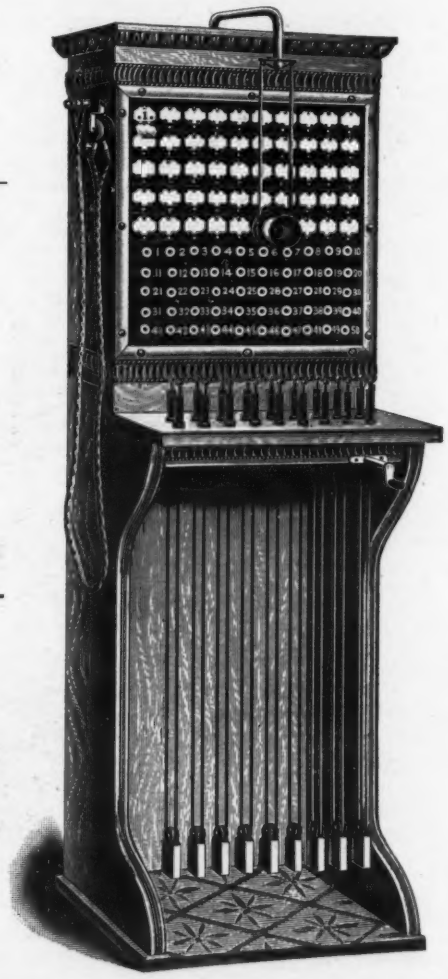


Fig. 3.—Bracket Suspension.



Two-Point Switchboard.

By pressing the jack to the right or left brings it into contact with the ring ing and listening contact points.

The novel features possessed by this board make it one of the most easily and quickly operated boards now on the market. It can be made in four different styles and is adapted for both metallic and common return circuits. One type has the magnet and drop mounted on the flexible jack, and should the magnet burn out it is easily removed without in any way interfering with any other drop or magnet. These boards are made in

cabinets of five drops up to any number desired, and Mr. Bailey will be glad to correspond with anyone interested in switchboards or contemplating establishing exchanges of any size or number of drops.

An Enclosed Arc Lamp.

In comparing the efficiency of enclosed arc with open arc lamps for service on street lighting and commercial circuits, the question of their respective candle power is naturally an important consideration. While it is true that with an enclosed arc the candle power is lessened somewhat, actual experience has proven that this loss is more than counterbalanced by the gain in steadiness of light, equality of diffusion and absence of shadow in the use of an enclosed arc. In the high-tension series lamp especially has this fact been developed.

The open arc series lamp in feeding loses nearly its entire efficiency of light, and the feeding process takes place every five to ten minutes. The enclosed arc lamp feeds only once in every four or five hours, and the rise and drop in voltage is so slight and gradual as not to be noticeable.

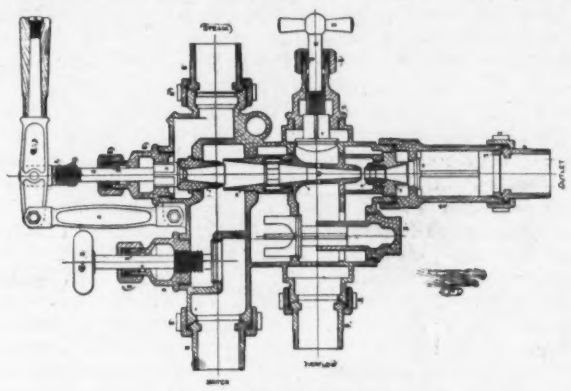
The Upton Midget enclosed arc series lamp, illustrated below, manufactured by the Standard Thermometer & Electric Company, Peabody, Mass., embodies in its mechanism all that is best and simple in the recent development of arc-lamp construction. It is designed so it can be easily adjusted to take from 65 to 80 volts as may be desired, and burn on from 4 1-2 to 7 ampere circuits without readjustment. Each lamp is provided with a switch, and an automatic cut-out, which is positive in its action. These lamps are now in use on street lighting and on commercial circuits, and the manufacturer claims to have flattering reports of their successful operation.

Automatic Single Tube Injector.

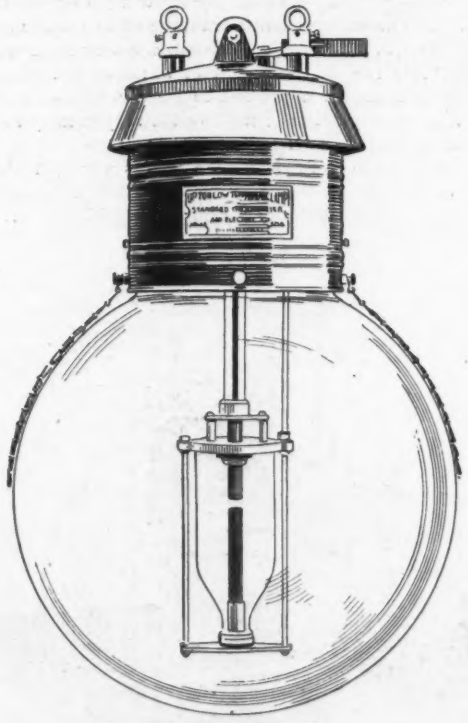
The Lunkenheimer Company, Cincinnati, Ohio, has recently produced an automatic single-tube injector to meet the demand for such a device in modern power-plant practice. By automatic is meant that should the machine stop forcing due from interruption of steam or water supply, the injector will re-start without attention as soon as the supply is resumed. In this injector the check valve is so made that it will not cut out, and even though it should not be perfectly tight it will not materially affect the operation of the machine. For this reason it is claimed to be the most desirable automatic injector on the market. It is simple in construction; has no delicate or complicated mechanism to give trouble, and the several parts are large and easy of access for examination and repairs without the use of special tools to remove the same. The injector will start promptly at all steam pressures from 30 pounds up to 250 pounds, and higher on lifts not exceeding 18 feet. In its operation steam is admitted by opening the valve, and it passes through the tubes and out the overflow. The water valves being open create a strong draught through the machine and suction pipe, discharging the air. The water rises in the suction pipe to the injector and is carried through the water-lifting tube and passes out up through the check valve, and up through the combined tube which discharges into the second and third overflow chambers. This discharge tends to throw the check valve to its seat, which causes all the water to pass through the combining tube and thence through the check valve into the atmosphere. As soon as the right proportion of steam is reached, the check valve is closed by the pressure of the atmosphere, the injector stops overflowing and the water passes into the boiler. The capacity is increased or decreased by throttling the water supply, and by this method it is possible to reduce the capacity fully 50 per cent. from the maximum discharge amount.

There are in this injector one-half the usual number of pieces, and attention is called to the fact that the steam and water valves and line check valve are all included in the injector casing.

These injectors are heavy and well proportioned throughout, the bodies being made of the best gun metal and the tubes and check valve of a special hard composition to withstand wear. They are particularly desirable for use on locomotives, lake and river steamers and power plants generally.



AUTOMATIC INJECTOR.



ENCLOSED ARC SERIES LAMP.

Electric Regulator for Dynamos.

A patent has just been issued to Mr. C. C. Gartland, an electrician, of Buffalo, N. Y., on an electrical regulator for constant series arc generators, which is especially adapted to the large Brush arc generators Nos. 9, 10 and 11. It can, however, be applied to others. On the Brush arc generator it is placed in the same position as the regular Brush device for regulating, which is now attached to the rheostat. The regulator consists of two mechanical parts, which are operated by a single electromagnet of new design, connected in series with the lamp circuit, and which throws the combination in and out of action. It has no sparking contacts to become oxidized and inoperative; no wall controller, no shunt coils or circuits, and when it is once adjusted to the desired current it will always remain so. It is unnecessary to touch the regulator when starting or stopping the generator, it being perfectly controlled by the current generated in the machine. The combined movements of rheostat and brushes are controlled with such promptness that a decrease or increase of about one-tenth of an ampere in the circuit will bring the regulator into action.

In the accompanying illustration the general arrangement of the regulator is shown. The spool (1) is wound to have a power sufficient to hold the armature balanced in line with the poles, acting, of course, against a

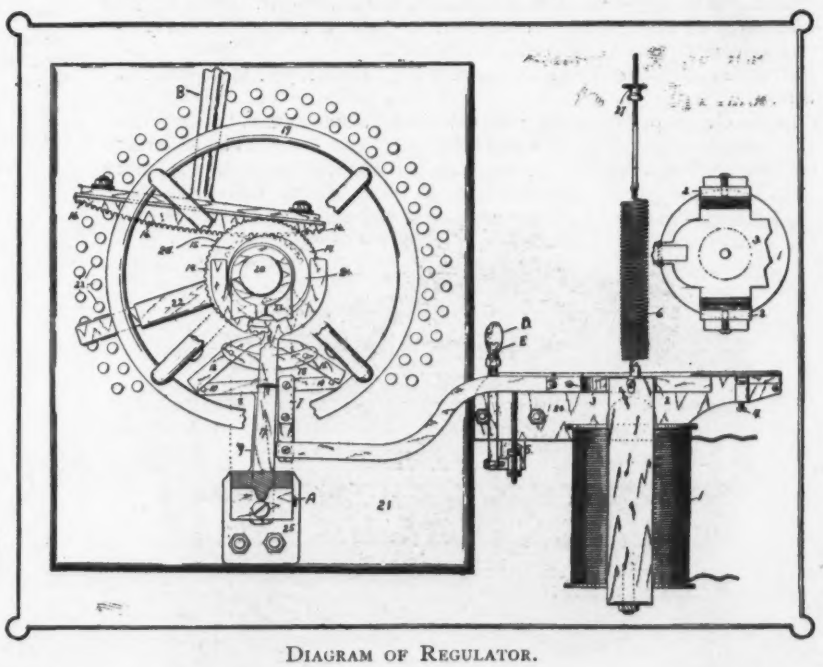


DIAGRAM OF REGULATOR.

tension spring, 6. In this condition the armature is maintained midway between the stops, and a rocking lever, which is connected to the armature by a connecting link, is maintained in a position which supports the pawls, 12 and 13, out of engagement with the ratchet wheels, 14, and the whole is in a state of equilibrium. Should the dynamo current decrease as a result of increase of load, or otherwise, the decreased power of the spool will allow the armature to be lifted by the tension spring, 6, and this will rock the lever, allowing the pawl to engage the ratchet wheel. The constantly oscillating arm, 17, will then cause the pawl to move the ratchet toward the right and slightly move the brush rocker in the opposite direction, and at the same time rotate the gear which meshes with the rack, thus moving the rheostat arm. A small belt driven by the armature shaft operates a pulley wheel which has a rigid eccentric, giving a constantly oscillating motion to the arm to which the pawls are attached.

The application of this regulator for constant potential is in the same manner as above described, the spool being wound according to the electromotive force required. It may also be applied to the regulation of alternating-current machines, as well as to separately excited machines generally, by connecting the rheostat in series with the field coils of the exciting machine. In the case of the alternating machine, the spool is preferably connected in the secondary circuit from a transformer, in which circuit a second rheostat operated by a spool in the primary circuit of the alternator is also interposed. The second resistance is so arranged as to give to the spool the same amount of current with 110 volts potential as with 100 volts, thus automatically taking care of the line loss in the primary circuit in exact proportion to the losses at any and all variations of load. When used to regulate the speed of machinery, the arm *B* is connected to a suitable speed governor and current is supplied to the spool from any convenient source.

Improved Röntgen-Ray Apparatus.

The increasing demand by the medical profession for Röntgen-ray apparatus which may be used with ease and certainty, and applied without fear of failure to what are now considered difficult cases, such as fracture of or dislocation of the hip, has led Messrs. Queen & Co., Philadelphia, Pa., to institute in their laboratory a series of careful experiments for the improvement of this apparatus in the various parts. One of the most important results of these experiments is the Queen self-regulating X-ray tube, which was fully described in The Electrical World of May 8. As further results important improvements have been made in induction coils, vibrators and condensers, and in the complete outfits.

In designing the new line of coils Messrs. Queen & Co. have given careful attention to proportioning the different parts so as to get a very heavy and continuous secondary discharge with the smallest possible amount of wire.

In the choice of insulating materials, and in assembling, the greatest possible care is used. Methods are employed which remove absolutely all air from the insulating material of the secondary. By these means it is not

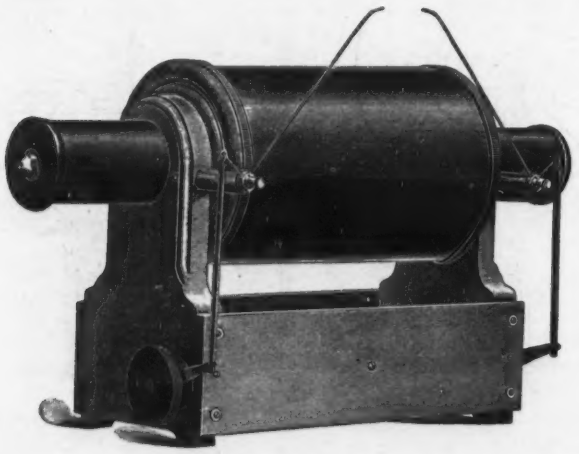


Fig. 1.—Induction Coil.

only impossible for the coils to break down, but small leaks, which diminish the efficiency and may develop in time into serious breaks, are entirely prevented.

The induction coil (Fig. 1) has neither vibrator nor condenser, being intended for use with the adjustable condenser and independent vibrator described herewith. The spark points are adjusted by the hard-rubber top shown at the left of the base, which is so well insulated that the operator is in no danger of receiving a shock even when the points are opened out to the full extent.

The coil is finished throughout in polished mahogany and hard rubber.

The condenser and vibrator for use with the coils are mounted together and are shown in Fig. 2. Two of the binding posts are connected to the batteries or lighting circuit, and the other two to the induction coil. The vibrator is operated by means of a small coil, which is a shunt from the main circuit. An independent set of contacts makes and breaks the circuit through this coil, and a switch near the binding posts opens and closes the shunt circuit. The main circuit is controlled by the reversing switch shown.

The vibrator, which is a very much improved form, is shown more in detail in Fig. 3. The movable platinum contact is carried on a small vertical spring behind the vibrator spring, and projects through a collar in the vibrator. When the contact is made the movement of the vibrator is not

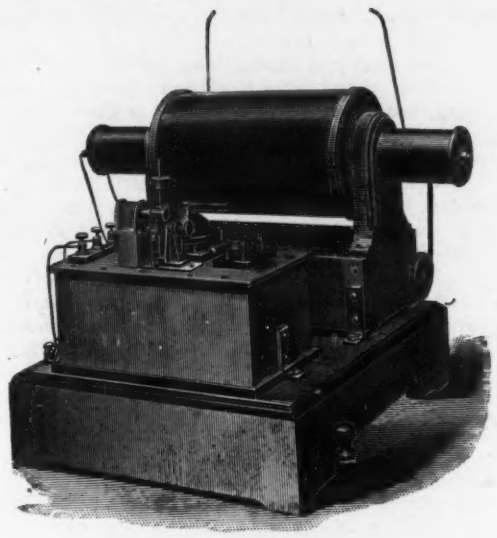


Fig. 2.—Condenser and Vibrator.

arrested but continues to its full amplitude, thus allowing a long "make." The length of the "make" can be varied by screwing in or out the other platinum contact. The most important advantage of this arrangement is the suddenness of the "break," which is accomplished by the collar in the vibrator spring striking the movable contact while at full speed. The suddenness of the break makes it possible to use this form of vibrator on the 110-volt as well as battery circuits; it also adds very greatly to the efficiency of the induction coil with which it is used.

A rod screwed into the top of the iron head carries a weight which may be moved up and down and clamped in any position with a set screw. By this means the rate of vibration may be varied within wide limits.

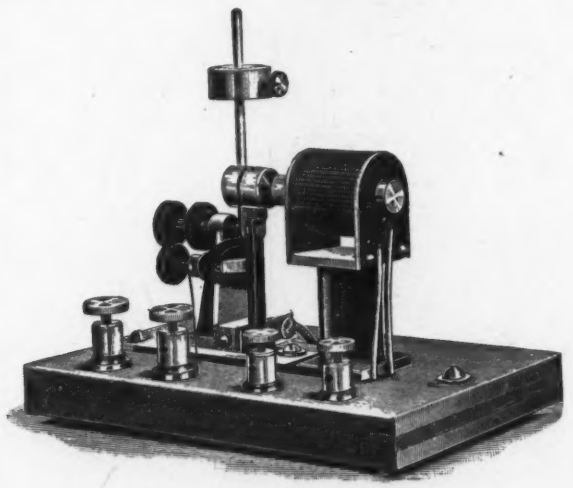


Fig. 3.—Details of Vibrator.

The adjustable condenser is an especially important feature where a vibrator with variable speed is used, as a capacity which is right for one rate of vibration is not correct for another. The contacts, throwing in the sections of the condenser, are made by spring plugs. This always insures a good and firm contact.

The outfits complete for X-ray work consist of a coil mounted on a base with rheostat if used for 110-volt circuit, and an adjustable vibrator mounted on the same base. In addition to this a number of tubes, suitable stand, fluoroscopes, etc., are included with each outfit.

In making up these outfits Messrs. Queen & Co. have aimed to combine the apparatus in such a way as to secure ease and certainty of operation, and at the same time powerful results.

New Closed Contact Electric Railway System.

Letters patent have just been issued to Messrs. W. W. Doty, J. A. MacKnight and Charles Granten for a new system of surface contact for electric railways, and we understand that these gentlemen will at once proceed to lay a section of track near New York City to demonstrate the merits of their invention. Experts who have examined the working model of the new railway system speak very favorably of it. In this new system the contact rail is placed midway between the track rails and is "dead," except at a point directly under the moving car. In other systems relays and cut-offs have been used to secure the dead contact rail, but in each one of these storage batteries, electromagnets and magnetic fields have been employed

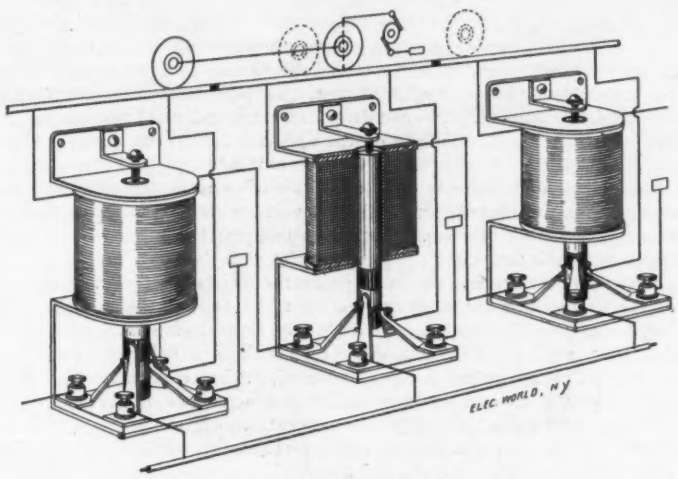
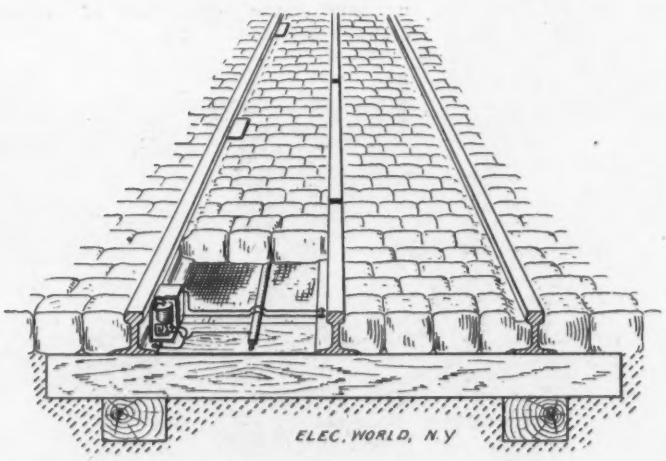


FIG. 1.—RELAYS AND THEIR CONNECTIONS.

for picking up the current. None of these devices is required in the new system. By an ingenious and simple plan of wiring the constancy of the contact through the action of current passing through the motors on the cars is assured.

What is claimed as a pre-eminent feature of the invention is that it can be applied to any street-car line without disfiguring the thoroughfares by poles or wires or open slots, and with only a slight disturbance of the surface of the street. In fact, no excavation at all is required below the surface of the ties, and the entire mechanism, including conduits for the insulated mains, contact rail and relay boxes, can be placed in an opening one foot deep and one foot wide—a mere gutter cut along in the centre of the space between the track rails. Other important claims made for the system are that it possesses all the good points and none of the defects of the overhead or underground trolley systems; that it will do away with all wires and poles in the streets now used for overhead trolley systems; that



POSITION OF RELAY BOXES ALONG THE TRACK.

it can be constructed for considerably less per mile than any system of electric railway now in use; low cost of operation and maintenance; and, finally, it avoids all the dangers incident to the overhead trolley wires. Among the minor advantages claimed are that the cars make less noise than those now in use operated by other systems; steadiness of electric light in the cars: easy motion of the cars and quick and easy control of the same.

The contact plates on the cars are two in number, in the form of connected shoes, which are fastened to the floor of the car about six feet apart. They are made sufficiently elastic by springs to enable them to adjust themselves to any inequality, and are sufficiently flexible to maintain their proper position, at the same time being rigid. Their under surface is sufficiently broad to render it impossible to break contact with the rail either on straight track or on curves. Ahead of each shoe is a steel brush which keeps the contact rail free from dust or mud.

The entire mechanism of the relay used in this system and the wiring which aids in producing the desired result are simple and may be readily understood from the accompanying illustrations. The relay consists of a solenoid magnet with a core composed of different materials in order that in its up and down movements it may perform the functions of a circuit-maker and circuit-breaker. It is practically indestructible, and has no bearings which require lubrication; no wearing or movable parts except the core, which moves up and down as the coil is energized or de-energized, and it cannot be burned out. The solenoids are placed at convenient distances apart along the track and are operated by a fraction of the current which is thrown ahead through the motor as the car advances, and even should the current fail through some accident at the power station every car on the line can pick it up the instant the circuit is re-established.

Each relay is placed in a water-tight iron box, and all the conductors are carried near the centre of the rail in conduit pipes which afford protection from dampness. The insulation throughout is so thorough that a short-circuit is said to be practically impossible.

The accompanying illustration, Fig. 1, gives a diagrammatic view of three of the relay boxes with their electrical connections. The plunger of the solenoid has an insulated section at its lower end, above which is a narrow section of metal, and above that is another insulated section. It is evident that when a solenoid is energized and the plunger is pulled upward, the two lower fingers are insulated one from the other, while the two higher ones are brought into contact with the metal section, thus establishing connection between the live-rail section and the solenoid ahead. As the car passes out of each section into the next the solenoid belonging to that section is de-energized, and the one in advance is energized in turn just at the moment the car is passing into the next section. The illustration shows very clearly the connections, which can be readily traced out.

In Fig. 2 is shown the position of the relay boxes with reference to the track construction. The office of the inventors is at 54 Stone Street, New York City.

A New Transformer.

A type of transformer of new mechanical design and embodying many marked improvements is announced by the General Electric Company. It is known as the type H, following the preceding types in alphabetical order. The core (Fig. 1) is built up of single rectangular punchings, assembled into a rectangular bundle with notched ends. The bundle, compressed under great pressure, is compactly held by a casing of insulating material, around which is wound one half of the low potential winding, leaving the toothed or notched ends only obtruding. Around this winding is an insulating wrapping, and over it one half of the high potential coil is wound. Two such cores and sets of coils placed side by side, with the ends of the cores interlocked into another set of rectangular punchings, complete the interior construction of the transformer.

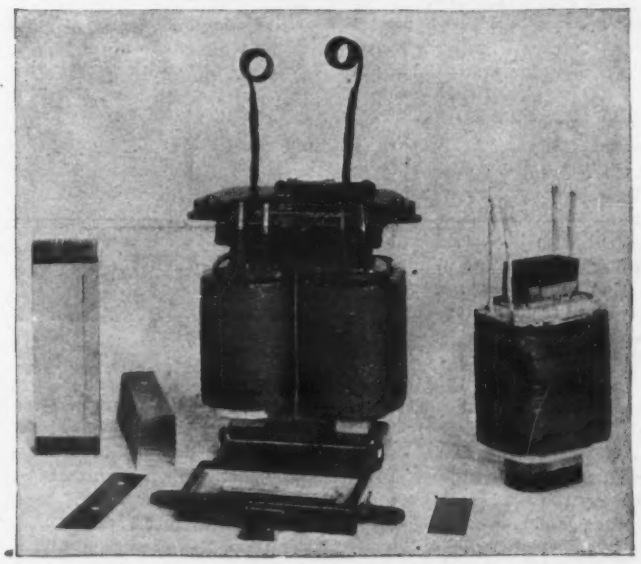


FIG. 1.—CORE AND WINDING.

Winding the coils upon a tightly compressed bundle of iron gives a practically solid mass without possibility of vibration either in iron or coils. From the type H is thus eliminated any objectionable "humming" or damage to insulation from constant slight motion of the coils. This is a distinct advantage, and still another is the one cylindrical rounding surface between the primary and secondary, doing away with corners or other surfaces inconvenient to insulate. A simple, plain cylinder of insulation, composed principally of mica, projects well beyond the winding, and

separates effectually the primary and secondary windings. The single set of windings is adhered to in all sizes, and possible breakdown of insulation, almost inseparable from several subdivisions of coils, avoided. To form as strong a barrier as possible against a high potential on the secondary, a

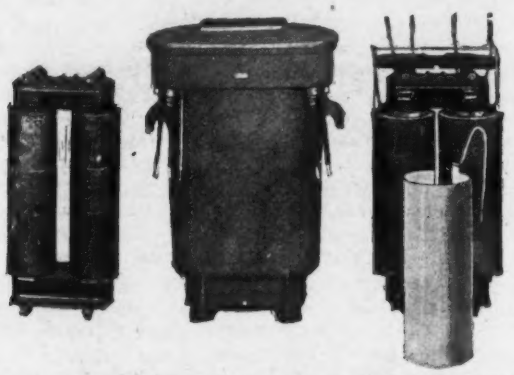
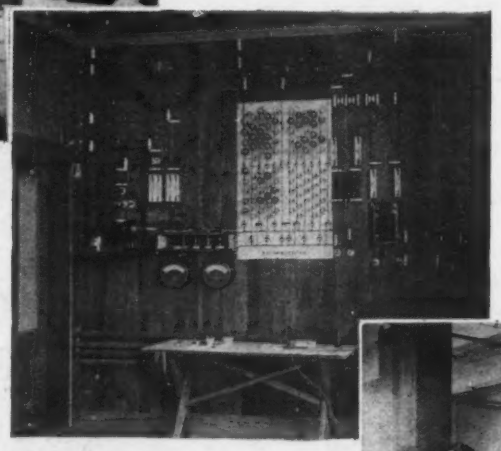


Fig. 2.—10-Kw Transformer, Showing Earth Shield.

protective device is added to the insulation. This is the so-called "Earth Shield," which is simply a sheet of copper placed between the primary and secondary windings and connected to earth. Thus even should the insulation between primary and secondary become pierced, this grounded shield would prevent any part of the secondary system being at any great difference of potential from the earth, and remove any possibility of danger to life and property due to high potential on the secondary winding. This is an important feature.

Machine Shop.



Testing Room.

Fig. 2 shows a 10-kw transformer of this type partially completed, the right-hand core equipped with its shield and another shield standing in front of it. While the General Electric Company does not provide this shield in standard transformers it can readily do so when required.

The relative position of the iron and copper in the design of the type H is reversed when compared with transformers of other makes. In the usual construction the copper is buried inside the core, and is, therefore, in the hottest part of the transformer, sometimes 75 degrees to 100 degrees F. above the temperature of any accessible part. This is the exact opposite of what is required, as high temperature in the copper means increased resistance, and consequently increased drop with reduced efficiency, as well as rapid and sure deterioration of the insulation. A moderately high temperature having no injurious effect on the iron core, in fact slightly reducing the loss in it, with coils on the outside and ample clearance between them and the case, a heavy insulating material is not necessary and any heat can readily escape, two conditions absent when the coils are inside the iron. The type H 60 cycle transformer operates at a lower temperature than any yet introduced.

The transformer can be used interchangeably for either of the two secondary voltages for which it is wound or on a "three-wire secondary" system. A connecting board placed in the case provides for a similar coupling of the two primary coils in series or multiple.

To those interested in looking still further into the construction of this transformer and the results that have been obtained with it the General Electric Company would be pleased to send, upon application, a copy of a treatise entitled "Use and Abuse of Transformers." This little pamphlet deals broadly with the transformer question much more thoroughly than is common in commercial literature, and is a valuable addition to the printed matter on this subject.

A Model Switch and Specialty Factory.

The Anchor Electric Company, Boston, Mass., owing to the steadily increasing demands for its porcelain cut-outs, snap switches and other specialties, has just removed its factory to new and more commodious quarters at 305 Congress Street, where it occupies the fourth floor, comprising upwards of 12,000 square feet. The accompanying illustrations present three interior views of the establishment, viz., the machine shop, the testing room and the assembling department, and serve to show the excellent facilities the company has for turning out its high-class work.

Entrance is gained to the factory through the office, which contains some very ingeniously arranged testing apparatus for testing snap and push button switches, porcelain cut-outs and the like, and a description of which will undoubtedly be of special interest. Three circuits enter the room—a 500-volt direct current, a 220-volt direct current, and a 110 alternating current. Mounted on the middle of the wall is a lamp-bank controlled by a combination of snap switches whereby any intensity of current can be obtained. A double-throw, double-pole switch on the left serves to connect the lamp-bank with either the 220-volt circuit or the 110-volt circuit. The switches to be tested are set in the box just below the double-throw switch and their terminals are put in series with the lamp-bank. A small induction motor drives a series of gears mounted on top of the box, and having prongs at their lower extremities which engage the handles of the snap switches. Upon starting the motor the switches are caused to operate just as in actual use, the number of revolutions being recorded by a counter. For operating the push-button switches a separate cam movement is provided, working in a similar manner. The upper double-pole switch on the right of the lamp-bank serves to throw on the 500-volt circuit, while the lower switch throws in a water resistance which is employed in testing porcelain cut-outs. The system is a most complete one, and is certainly very well adapted for testing apparatus under the same severe conditions that are met with in actual practice.

Leaving this room the visitor enters the stock department, where dozens of large bins are conveniently arranged in sections to accommodate the innumerable small parts required in making up the specialties. Here also are the assembling tables where deft hands are at work assembling the parts. Beyond are the metal racks holding the brass bars and rods, by the side of which is a large dipping tank covered by a hood, which is used for dipping the brass.

The machinery department is located at the far end of the building and, as the cut shows, contains a very complete assortment of drills, lathes, shapers, milling machines, power and hand punches, besides several screw machines, which are driven by a 10-hp electric motor. In addition to its regular line of goods, the Anchor Electric Company has constantly on hand large quantities of machine screws of the standard sizes.

Assembling Department.

Among the well-known Anchor specialties may be mentioned the following: Single, double, triple and four-pole snap switches, push-button and flush switches, iron pockets, single and in gangs, besides high grade lamp sockets and lamp receptacles. In addition the company makes a large variety of porcelain cut-outs, both for ceilings and fixtures. The Anchor Electric Company employs about 85 hands in all, and the excellent facilities which it has make it possible to manufacture any kind of special switch work in a thoroughly efficient and workmanlike manner. The three views of the interior of the company's factory show it to be a busy place.

A Turbine Water Wheel.

Coincident with the development of long-distance electric-power transmission, the utilization of water powers has become one of the most important branches of engineering science. The availability of water falls for the generation of electric power has become one of the most interesting problems that the engineer has ever been called upon to deal with, and the concrete results of his work are an excellent testimonial to the engineering skill that has been developed as a result of the expansion of this broad field of industry.

Having the water power, the first step in its useful development is to transform it into mechanical power, which is usually accomplished through the instrumentality of a water wheel or turbine.

There are many such wheels on the market, and the stage of refinement to which they have been brought reflects much credit upon the engineering skill applied to the solution of the many problems involved in this class of engineering work.

The Rechard turbine water wheel, manufactured by Messrs. Baugher, Kurtz & Stewart, York, Pa., deserves particular mention on account of the claims made for it by the manufacturers.

This wheel was designed with two objects in view, namely: useful effect and durability, and in both of these, it is said, a full measure of success has been attained.

The wheel was tested by the Holyoke Water Power Company, Holyoke, Mass., and the report of the tests, it is stated, compare very favorably with those of the best wheels tested during the hydro-dynamic experiments made by that company in 1879 and 1880.

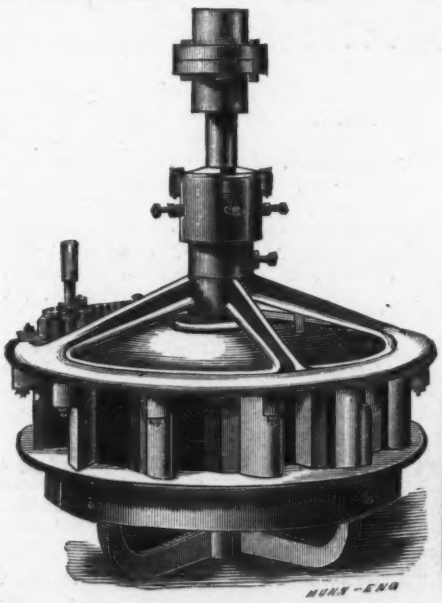
A brief description of the construction of the wheel will facilitate an understanding as to its operation. Immediately above the crown plate is arranged a hub having a series of arms extending radially to a ring located at the outer end of the crown plate. The upper surface of this ring is provided with a raised back to engage with a pinion mounted on the upper surface of the crown plate of the wheel for the purpose of opening and closing the gates. The under side of this ring is made with a number of recesses terminating in cam faces at the forward and rear surfaces. These recesses are mediums for operating the pivoted gates. The ring, which is called the cam ring, is provided with an overhanging lip to keep the joint free from sand and rubbish. The circular flange which forms part of the bottom plate prevents all springing or straining from the weight of the water or otherwise. The spider is secured to the inner side of the circular flange of the bottom plate by means of shoulders resting on a reverse shoulder projecting from the inner side of the flange.

The runner consists of a hub, a conical crown and buckets, and is of the downward discharge type. The body of the bucket inclines forward at a considerable angle to the radial line and in the direction of the movement of the wheel, and throws the water out to the periphery where it effects the greatest leverage. This inclination of the buckets permits of entering the incoming streams of water edgewise, with no resisting surface to produce backlash and loss of power in the wheel.

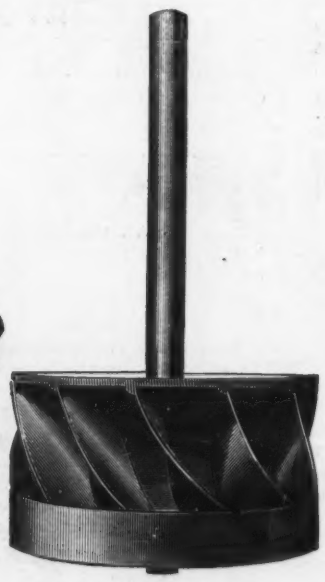
The gate is curved in shape and is constructed with an enlargement near its inner end, which is perforated to receive the securing bolt and a lug at its upper end, with a pin projecting upwardly into the recesses of the cam ring. These gates are provided with brass or other non-corrosive metal bushings, cast or fit in, so as to form part of the gate, and the pins used in this connection are made of the same metal, thus insuring a joint free from rust, and one that will not bind. The pins or studs on the upper surface of the gates near the outer end rest loosely in the recesses of the cam ring, so that when the cam ring is moved in one direction the cam surfaces will come in contact with the studs and open the gates. When the cam ring is moved in the opposite direction, half its travel, the gate is closed by the pressure of the water, thus making the gate self or automatic closing to that extent.

The results of tests indicate that this wheel is very economical in the use of water at about three-fourths discharge, and users of such a wheel as this are enabled to get the full benefit of the stream either in its highest or lowest supply.

PLAN VIEW OF THE TURBINE.



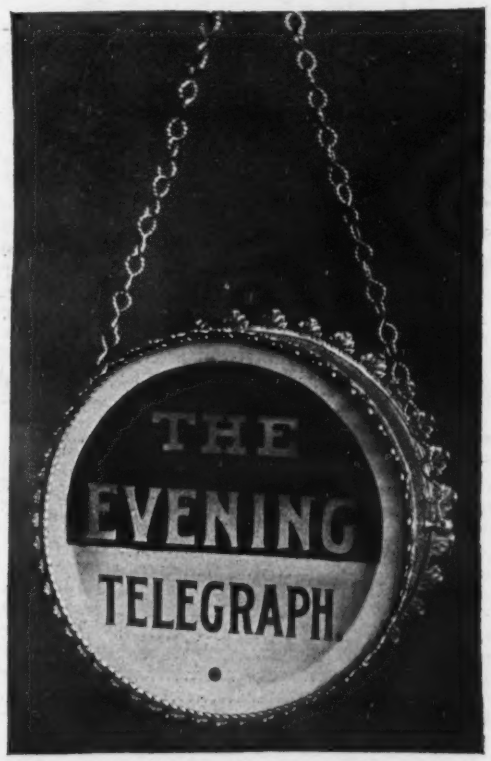
THE TURBINE WHEEL.



THE RUNNER.

A Prismatic Electric Sign.

At the convention of the National Electric Light Association which was held at Niagara Falls during the present week were exhibited by Mr. C. H. Hill, of Williamsport, Pa., various samples of the prismatic electric sign invented by himself. This device consists of a metal drum with glass front and solid back, or glass may be employed at both front and back, if desired. Its obvious use is for display of advertisements, for which purpose it readily lends itself with very pleasing results. The advertisement is placed on the ground glass and when the device is in full operation five different colors are transmitted through the glass about twice a minute. A combination of any two colors may also be obtained if desired. The diameter of the glass as shown in the illustration is 21 inches, but it can be made any size to meet special requirements. The illumination is effected by a mechanical movement which, when wound up, will run for about 10 hours. The lights are turned on and off by an ordinary switch placed at a convenient point, the switch being operated by mechanism. It is stated that this device is very economical to operate as regards consumption of current. The cases can be finished after any design or to suit any individual fancy. A patent on the device has been applied for by Mr. Hill.



PRISMATIC ELECTRIC SIGN.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, June 7, 1897.

ELECTRICAL STOCKS.—The market, generally speaking, showed a stronger tone than it exhibited last week, and prices are in most instances higher. Advances are recorded in Brooklyn Edison, Electric Storage Battery, both issues, and General Electric common. The preferred stock of the latter closed at a loss of 1 point. The rest of the list is practically unchanged. The sales of General Electric stock during the week amounted to 3505 shares, the net advance in price being 1 point.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	116	117½
Edison Electric Ill., Brooklyn	100	107	109
Edison Electric Ill., Boston	100	147	148
Edison Electric Ill , Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	19	19¼
Electric Storage, pref	100	20⅛	21½
General Electric	100	31½	31⅝
General Electric, pref.	100	67	70
Westinghouse Consolidated, com	50	21	23
Westinghouse Consolidated, pref	50	50	51
BONDS.			
Edison Electric Ill., New York, con. 5s	105	112	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	97½	98
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	229	230
American District Telegraph	100	..	35
American Telegraph and Cable.	100	88	90
Central and South American Telegraph	100	124	127
Commercial Cables	100	170	..
Erie Telephone	100	64	65
New England Telephone	100	106¼	108
Postal Telegraph Cable	100	100	..
Western Union Telegraph	100	79¼	79⅞
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	19⅛	19¼
Brooklyn Rapid Transit	..	20	20¼
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	69	71
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	42	44
Hestonville	100	50½	51
Hestonville, pref	..	..	62½
New Orleans Traction	100	6	8
New Orleans Traction, pref	100	25	28
North Shore Traction	100	18	20
North Shore Traction, pref	100	75	78
Rochester Street Railway	..	10	13
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	..	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	78¼	79
West End, Boston, pref	100	91¼	92
Worcester Traction	100	12	15
Worcester Traction, pref	100	88	91
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	73	..
Buffalo Street Railway 1st con. 5s	100	*106½	108½
Cleveland Electric Railway 1st mtge., 5s	100	103	105
*Columbus Street Railway 1st 5s	100	94	96
Rochester Street Railway 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge. 5s	..	105	107
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest.

TELEGRAPH AND TELEPHONE.—These classes of securities show no marked changes in prices. American Bell is 1 1-2 points higher, and the other telephones are firmer. Of the telegraphs Commercial Cable is the only stock showing an advance, closing at 170—7 1-2 points higher than at the close of the previous week. Western Union is a fraction lower, the sales for the week amounting to 28,589 shares.

ELECTRIC TRACTIONS are dull and prices are practically unchanged. Worcester Traction exhibited some strength, and Buffalo consols have also been in good demand, with but light offerings. Brooklyn City is down a bit, due, it is said, to strike talk. The unsettled weather and consequent diminution of Sunday traffic is also referred to as a cause of the dullness in this stock. The Buffalo Railway Company has declared a quarterly dividend of 1 per cent., payable June 15.

STREET RAILWAY EARNINGS.—The Columbus Street Railroad Company reports gross earnings for May of $49,170, a decrease of $8,999, as compared with the same month of last year; and net earnings $26,086, a decrease of $6,045. For the five months ending May 31 the gross earnings were $233,087, a decrease of $26,034, as compared with the corresponding period of last year, and net earnings $121,410, a decrease of $6,976.

TO LIST MORE STOCK.—The Western Union Telegraph Company has applied to the Stock Exchange to list $2,000,000 par value treasury stock, which it has sold to J. P. Morgan & Co. It is stated that the price obtained by the company was 76. This issue increases the outstanding capital of the company to $97,370,000, leaving $2,630,000 in its treasury. It is stated that the sale of this stock is made to provide for the part payment for new lines, addition to its permanent plant and for property acquired and constructed during the four fiscal years ending June 30, 1896.

DIVIDENDS.—The Edison Electric Illuminating Company of Brooklyn has declared a quarterly dividend of 1½ per cent., payable on July 15. . . . The Western Union Telegraph Company has declared a quarterly dividend of 1¼ per cent., payable July 15. The company reports for the quarter ending June 30, net revenues $1,550,000, an increase of $149,800, as compared with the figures of 1896; interest and sinking fund $203,875, an increase of $371. Balance, $1,346,125, an increase of $149,429. Dividend, $1,216,975, an increase of $25,015. Total surplus, $7,688,989, an increase of $45,204.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, June 10, 1897.

MR. STERLING L. BAILEY, of Chicago, who makes the two-point switchboard described and illustrated on another page in this issue, made a pleasant call at the office of THE ELECTRICAL WORLD during the past week.

MUNICIPAL OWNERSHIP LEAGUE.—A municipal ownership league has been incorporated in Brooklyn to advocate the ownership by cities of all railroads, public franchises, gas and electric plants, water works, etc. Among the incorporators, however, no prominent name appears.

ELECTRIC RAILWAY COMPANY DISSOLVED.—The Electric Railway Company of the United States has been dissolved by order of Judge Truax of the Supreme Court, and temporary receiver Arthur Ingraham has been made permanent receiver. The company's office was at No. 1 Broadway. Its liabilities were $28,250 and its assets $5,041.

MR. JOHN STARR, of the electrical supply firm of John Starr, Son & Co., Limited, Halifax, N. S., made a call at the office of THE ELECTRICAL WORLD during the week. Mr. Starr is on the lookout for electrical novelties and reports business in his section quite good. The citizens of Halifax, he states, are preparing a grand electrical illumination to celebrate the Queen's jubilee.

ACCUSED OF EMBEZZLEMENT.—On June 9, Mr. William R. Brixey, the manufacturer of Kerite wires and cables, made a formal charge of embezzlement against Mr. J. E. Ham, late general agent for the concern. Attorney John F. McIntyre, who appeared for Mr. Brixey declared that the books of the firm showed a deficit of $4000. The specific charge against Mr. Ham was the larceny of $82.30, which, it is alleged, he collected from a Maiden Lane jeweler last December and appropriated to his own use. Mr. Ham was subsequently released on $2500 bail.

BRIDGE TROLLEY CAR PLANS.—The plans for the crossing of the trolley cars on the bridge have been filed with Chief Engineer and Superintendent Martin, who already has in his possession the plans of the Brooklyn Elevated Railroad Company. As the plans involve the incroachment upon the property of the Manhattan Elevated Railroad Company at the New York end, the consent of that company will be necessary before any further steps can be taken in the matter. After this point has been settled with the Manhattan Railroad Company, it is stated that everything will be clear for the execution of the proposed work.

ELECTRICAL MACHINERY FOR THE PERUVIAN EXHIBITION.—It is stated that the Peruvian Permanent Exhibition for Machinery, which is to be inaugurated at Lima, Peru, on July 28, is meeting with good support from American manufacturers. An unusually heavy consignment is being prepared for dispatch to Lima by the Westinghouse Electric & Manufacturing Company, through the firm of W. E. Peck & Co. All machinery or manufactured goods sent to the exhibition are exempt from import duty. The steamer which left New York City on July 10 for Lima carried several packages of machinery for the exhibition.

ELECTRICITY TO COMPETE WITH GAS.—Mr. Charles Cooper, president of the Kings County Electric Light Company, Brooklyn, has secured permits for the opening of a number of streets in that city and will lay twenty-five miles of conduits and wires for his company. The Kings County Company secured a franchise from the Board of Aldermen in 1895, but has never used it except to lay twelve miles of conduit in Court Street. Mr. Cooper now says that the company has a fully subscribed capital of $1,000,000, and has secured an option on a piece of property where a large and complete electric plant will soon be erected. Mr. Cooper stated that it is not the intention of his company to compete with the local companies in their present fields. His company will produce light, heat and power on the Tesla multi-phase system, under which system he claims that light and power can be furnished at low cost.

THE AFFAIRS OF THE E. S. GREELEY & COMPANY.—The recent rumors regarding the alleged discovery of crookedness in the accounts of The E. S. Greeley & Company seem to have had some foundation in fact. Mr. J. W. Sands, who was secretary of the company, it is now stated, was arrested on May 7 last, and lodged in Ludlow Street jail. He was sued for about $60,000 of the company's money, and bail was fixed at $40,000, which was furnished on the day of his arrest by his son-in-law, Architect William H. Russell. When the company failed in October last, Gen. E. S. Greeley and Mr. J. W. Sands were appointed receivers. Messrs. Jones & Laughlin, of Pittsburg, put an expert accountant at work on the Greeley Company's books. The accountant, Mr. Frederick W. Child, reported that Sands had systematically falsified the company's accounts and that $60,000 was missing. A complaint based on Child's discoveries was made, and Justice Smyth issued an order in a civil suit for Sands' arrest, the being disposed of as above noted. General Greeley, it is stated, had entire confidence in Mr. Sands' integrity, and was deeply grieved and astounded when the first inkling of the trouble and the author of the same was brought to his notice. It was with great reluctance that he acted upon Judge Lacombe's order to bring action against Sands. According to the accusation against Sands, he is charged with having misappropriated, misapplied and secreted $61,370.48 of the company's money between January, 1888, and October 7, 1896. A transcript of a judgment from Westchester County was filed in the New York County Clerk's Office on June 10 against Sands for $83,178, in favor of E. S. Greeley, as auxiliary receiver of the E. S. Greeley & Co. This amount represents the balance due the firm, and is additional to the amount involved in the first suit, a part of which, we understand, has been made good.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., June 8, 1897.

EASTERN INDEPENDENT TELEPHONE INTERESTS.—Messrs. Whitman and Couch have received such a generous response to their circular letter suggesting a consolidation of Eastern independent telephone interests that they have called a meeting, to take place Wednesday, June 16, at 10.30 A. M., at 196 Summer Street, Boston. The object of this meeting is wholly in sympathy with the national organization, and is with the view of sending representatives of the Eastern interests to act in behalf of the Eastern organization.

POPULARITY OF WOVEN WIRE BRUSHES.—The Crown Woven Wire Brush Company, Salem, Mass., reports large orders of new woven wire pencil brushes, which are designed especially for fan motors. The brushes have met with a great deal of favor, and the consumers say that they give much better service than those made of carbon, due to the fact that they wear longer, produce less heating and noise. The phosphor bronze and alloy brushes are selling very fast, owing to the recent cut in prices. The company is also manufacturing woven wire brushes for radial use on multipolar machines.

ENCLOSED ARC LAMPS.—During a recent visit to the Standard Thermometer & Electric Company's factory at Peabody, Mass., we were shown some very flattering letters from central station managers in various parts of the country, speaking in very high terms of the company's new high-tension series enclosed arc lamps for 6.8 ampere circuits and also the enclosed arc lamps for 110-volt circuits, which can also be operated two in series on 220-volt mains or five in series on 550-volt mains. The company is also shipping constantly open arc alternating lamps, which have the merit of working equally well on any number of alternations from 6000 to 16,000 without change of adjustment.

ELECTRICITY IN DENTISTRY.—Electricity in its relation to dentistry was one of the topics for discussion at the annual meeting of the Massachusetts Dental Association, held at the Harvard Dental School, Thursday, June 3. Mr. James L. Gethins, of the Burnham-Gethins Co., inventor of the well-known "Gethins Gravity Cell," who has given a great deal of attention to the study of the application of electricity to dentistry, exhibited a dental engine with battery and other apparatus, and also delivered an address on the use of electricity in "Cataphoresis." He emphasized particularly the fact that it was the quantity of electricity and not the voltage which acts upon the tooth, and showed that an outfit consisting of a few cells of the proper type is all that is necessary instead of the large number usually advocated, which causes unnecessary pain to the patient. He also stated that too much guesswork has entered into the operation, and advocated very strongly the use of a mil-ammeter to measure the precise strength of the current.

A PIONEER ELECTRIC COMPANY.—The Bernstein Electric Company, Boston, was the first company to exploit the series incandescent system, starting the manufacture of lamps in the latter part of the year 1879. Ever since that time the company has devoted its energies toward perfecting this type, and it now manufactures a filament adapted to series lamps and made with special regard to the high currents and excessive fluctuations which are met with in this system. It has recently issued a very neat circular calling attention to its railway lamp, the filament of which is peculiarly fitted to withstand the vibrations of electric cars. A very large part of the business is devoted to the manufacture of numerous styles of street brackets for series incandescent lamps as used on arc and alternating street systems. The celebrated Bernstein series socket, as is well known, has been on the market for many years. Recently one was returned to the factory which had been in constant use for over twelve years, a fact which emphasizes the extreme durability of these sockets.

ELECTRICITY IN ORIFICIAL WORK.—The thirty-seventh annual meeting of the Massachusetts Eclectic Medical Society was held at Hotel Thorndike, June 3 and 4. On the second day a very interesting paper was read by Nathan L. Allen, M. D., on "Electricity in Orificial Work." In order to demonstrate the method of operation and apparatus required the speaker made use of a "Faradic" coil, manufactured by the Ziegler Electric Company, Boston, which was capable of giving two forms of current, either continuous or vibratory, when used in connection with four cells of battery. In concluding the lecturer paid a very high compliment to the efficiency of the instrument. Following this, Dr. John Perrin gave some very interesting data relative to a recent case of "Sarcomata of the Bones," the development of which was easily followed after an operation had been performed by means of an X-ray outfit furnished by the same company. After the meeting had been adjourned, the physicians were given an opportunity of examining an excellent display of electro-medical apparatus made by the Ziegler Electric Company, consisting of medical batteries, coils, etc. The company took this opportunity to exhibit its new static machine as well as the Monell X-ray tube, for which it is New England agent. This tube has been adopted by Dr. Monell, of New York, an X-ray specialist, after carefully testing most of the well-known tubes manufactured in this country and elsewhere.

PITTSBURG NOTES.

PITTSBURG, Pa., June 7, 1897.

LARGE GAS ENGINES.—The Westinghouse Machine Company has completed the drawings for what will probably be the largest gas engine ever built—certainly the largest on this side of the ocean. It will have a capacity of 700 horse-power. The patterns are now being made for the machine, which will be completed and tested at the earliest possible moment. If in its actual operation it proves to be a success, and meets the expectations of its designers, this engine, it is rumored, will be purchased for the Allegheny County Light Company's Twelfth Street plant, where its satisfactory performance will doubtless mean the installation of one or two more gas-driven units of the same size and design. The Westinghouse Machine Company reports orders received last week for four steam engines of 1000 horse-power each, one for Boston and three for New York. These will be of the steeple compound type, similar to those built for the Westinghouse lighting plant at the World's Fair.

BIG STREET RAILWAY DEAL PENDING.—Renewed efforts are being made by the Alexander Brown syndicate of Baltimore, who control the Northside Traction Company, to secure possession of the Pittsburg Allegheny & Manchester road. Many overtures have been made to the Pittsburg, Allegheny & Manchester stockholders to induce them to sell, and a majority of them have been disposed to do so. A very strong minority, however, has always succeeded in blocking the proceedings. At a directors' meeting held on June 4 the Brown syndicate's latest proposition was discussed, and it is stated that one of the most influential and aggressive of the objecting minority signified that he would no longer oppose the sale. Under these circumstances it is thought that the other stockholders will acquiesce. The Brown syndicate offers to purchase the entire capital stock of the Pittsburg, Allegheny & Manchester Company, 60,000 shares, at $41 per share, of which $25 will be paid in cash and $16 in five per cent. bonds of the consolidating company. This will be known as the Union Traction Company, a corporation formed for the purpose of consolidating the Second Avenue, Pleasant Valley or Northside, West End, and Pittsburg, Allegheny & Manchester traction systems. If the deal goes through it will mean that practically all of the street railway lines in Allegheny County will belong to one or the other of the two great systems, the Consolidated Traction Company of Pittsburg, or the Union Traction Company.

CLEVELAND NOTES.

CLEVELAND, O., June 5, 1897.

PICNIC GROUNDS.—The Cleveland & Chagrin Falls Electric Railway Company has just purchased forty acres of land on the line of its road, which is to be converted into picnic grounds.

ANOTHER CROSS TOWN LINE.—A new street car line has been proposed for the east end of Cleveland and Glenville. The proposition is to run a direct line from Woodland Hills Avenue and Broadway to the lake by way of Doan Street.

BOND FILED FOR THE COMPLETION OF LINE.—The Buckeye Traction Company has just filed a bond for $3000 with the Crawford County Commissioners, binding the company to begin work on the Bucyrus & Galion trolley road. The road must be in operation by January 1, 1898.

APPOINTMENT OF RECEIVER.—C. A. Ennis has been appointed receiver of the Bedford Electric Light & Power Company. The appointment was made by Judge Neff, on the application of the minority stockholders. The company has been engaged for several months in a fight with the Akron, Bedford & Cleveland Railroad Company, as to which of them shall light the village.

LIVELY WAR.—There is a lively rate war now going on between the new electric road from Cleveland to Chagrin Falls, and the Cleveland, Canton & Southern steam road. The latter is now charging a fare of ten cents, whereas the fare on the electric road is twenty-five cents. The Lake Shore & Michigan Southern Railroad has also cut its rates to Berea and Elyria to compete with the Cleveland & Berea electric line.

APPLICATION FOR A FRANCHISE.—Application has been made to the County Commissioners of Cuyahoga County by the Cleveland & Mayfield Plank Road Company, and the Cleveland & Eastern Railroad Company, for a franchise for the latter company over the former's road, which runs from Euclid to Orwell, in Ashtabula County, a distance of fifty-one miles. The road company wants to give a franchise for fifty years for both passenger and freight traffic. The consideration mentioned in the agreement is $400 a year for ten years. One of the Commissioners is strongly opposed to granting a franchise for carrying freight. He says that if the company wants to do a freight business it should purchase a private right of way, and not be allowed to use a county road.

Chicago Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
Chicago, Ill., June 7, 1897.

VISITORS.—Messrs. Samuel D. Latty and J. A. Williams, of the Williams & Abbott Electric Company, Cleveland, Ohio, called at The Electrical World office during the past week. Both of these gentlemen are well pleased with the business outlook.

REMOVED.—Mr. A. M. Morse on June 1 removed from 1249 Marquette Building to suite 1108 and 1109 same building, where he will make a specialty of high-grade engines for electric service, of both Corliss and high-speed types. Mr. Morse has had a wide experience in steam-engineering work, and has equipped many of the representative power plants in the Southwest. For the past five years he has been the selling agent for the Buckeye Engine Company for the St. Louis & Chicago territory, but severed his connection with that company on June 1.

St. Louis Notes.

St. Louis, Mo., June 7, 1897.

PEOPLES RAILWAY.—A majority of the stockholders of the Peoples Railway Company held a meeting June 5. Trustees were appointed to bid for the road in the interest of the stockholders, when it comes up for sale at auction on June 29.

MAY BUY THE ROAD.—Messrs. F. W. Roebling and Thomas C. Barr are in the city. The former is the senior member of the firm of John A. Roebling Sons' Company, New York, and the latter a prominent Eastern street-railroad man. They, and Charles Green, are interested in buying the Peoples line at the foreclosure sale. If they secure the property they propose to reorganize the company, change the motive power to electricity, and make the road first class in every particular.

FRANCHISE ACCEPTED.—The St. Louis & Suburban Railway Company has accepted the franchise tendered by the Board of Trustees of Kirkwood for the St. Louis & Meramee Railway, to run from the terminus of the Webster division of the Suburban to Meramee Highlands, passing through Kirkwood. The Suburban gave its bond in the sum of $15,000 to indemnify the town of Kirkwood from loss in the construction of the road. Work will begin on the new road this week, and it is expected that it will be in operation not later than August 15.

New York State Notes.

A MUNICIPAL PLANT.—The town of Mohawk, N. Y., is installing an electric lighting system, which will be under the supervision of commissioners. The Fort Wayne Electric Corporation, of Fort Wayne, Ind., is doing the work. The engine and boiler plant was erected by the Atlas Engine Works, of Indianapolis, Ind. Forty-three street arcs will be erected, using a 60-light, 2000-cp machine. Later work will be pushed forward on the incandescent lighting, and a 60-kw Fort Wayne alternator will be installed for this end.

A MODEL WATER-POWER ELECTRIC STATION.—The United Gas & Electric Companies of Little Falls, N. Y., are equipping a new station on the old A. T. Stewart mill privilege, which, when completed, will be one of the best arranged central stations in New York State. The dynamo room has a floor space of 7000 square feet. The main shaft will be 114 feet long, the sections coupled with Worrall clutches. Two new water-wheels are now being installed by the Rodney Hunt Machine Works, Orange, Mass. They are of the latest McCormick horizontal type. The wheels are being placed nearly under the centre of the line of shafting, and will be belted directly from the wheel shaft to the main line. The belts under the building and the drive wheel on the pulleys will be protected from back water by a belt pan. The receiving pulley and main line of shafting will be supported independently on quills. The two wheels will aggregate 400 horse-power. This privilege is one of the finest in the region, having a fall of about 23 feet, and General Wm. F. Lansing, manager of the company, figures on obtaining a working head of 19 1-2 feet. At either end of the shaft will be stationed a McIntosh & Seymour high-speed engine of 175 horse-power. There will be a separate boiler-house containing a battery of three boilers, aggregating 425 horse-power, one Bigelow (New Haven) and two Phoenix (Syracuse) boilers. This brick boiler-house will have 2530 feet floor space. All the machinery in the old stations will be brought into the new one, and besides much additional electrical apparatus will be installed, including a new 2000-light Thomson-Houston alternating machine, and a new Thomson-Houston generator for furnishing power for commercial and manufacturing use. The building has an ideal situation, presenting large windows to the east and west. The arrangement of the machinery and belting is also such as to give ideal conditions, making underdraughts on all the belts. The plans of the company call for immediate extension in every direction of its business. A power circuit for small motors for factory purposes is one part of the plan, and to have ready by the middle of summer a day-lighting circuit is another.

Canadian Notes.

Ottawa, Ont., June 5, 1897.

WAR OF LIGHTING RATES.—Montreal is likely to have a lighting-rate war this summer, and a very considerable reduction in the cost to householders of domestic illuminations is among the possibilities of the near future. As soon as the new works at Lachine Rapids, of the Lachine Hydraulic & Land Company, are completed, which will be toward the end of June, the directors of that company will announce a reduction of 25 to 40 per cent. in its rates for electricity for lighting and power service. Other companies, it is expected, will follow suit.

A NEW SUMMER EVENING RESORT FOR MONTREALERS.—An extension of the Montreal Street Railway Company's system through Verdun, to the new property of the Lachine Hydraulic & Power Company, is projected for the summer. Negotiations to that end are now in progress, and if they can be successfully concluded a passenger will be able to go out to the Rapids or come into the city from there by the payment of an extra ticket. The Lachine Hydraulic Company is about to lay out a large public park there, with electrical fountains and other attractions, which, when completed, will make the spot a favorite evening summer resort for Montrealers.

ELECTRIC RAILWAY FRANCHISE.—A special meeting of the Town Council for Niagara Falls, Ont., discussed a by-law for an electric railway. The by-law as introduced gave the company holding the present charter for the horse-car line a twenty years' charter, with the privilege of running over the same route with a few extensions, providing the company put in locomotive power other than horses or steam. The company must act within thirty days of the passing of the by-law, and complete the line within sixty days. Provision was also made for trunk lines to have running powers over the line. The Street Railway Company's representative objected to several of the clauses in the by-law, but when it is carried the company will doubtless accept the terms. If it does not, the Lundy's Lane Electric Railway Company will probably get in ahead of it.

Montreal, Que., June 5, 1897.

PICTOU, ONT.—The ratepayers will be asked to vote a sum of $12,000 to improve the electric light plant.

LONDON, ONT.—It is the intention of the London Street Railway to extend its line to Pottersburg, at a cost of $10,000.

KINGSTON, ONT.—The Kingston Street Railway Company proposes to make several improvements this spring, including the extension of the line to the depot.

QUEBEC, QUE.—It is rumored that Mr. H. J. Beemer will seek a charter for the construction of an electric railway between St. Joseph de Levis and Chaudiere.

LONDON, ONT.—The London Street Railway Company will probably build a road to Lucan, permission having been granted at the last session of the Ontario legislature.

PORT WILLIAM, ONT.—The ratepayers will be asked to grant the sum of $35,000 for water works, and $13,000 for an electric light plant. Voting will take place on July 9.

WINDSOR, ONT.—Surveys are being made for an electric railway from Amherstburg to Windsor, the plans of which have been filed in Toronto by Mr. Auld of Amherstburg.

CHATHAM, ONT.—The City Council has under consideration the purchase of an electric light plant, as authorized by a vote of the ratepayers in February last. The cost will probably be about $15,000.

English Notes.

(From Our Own Correspondent.)

London, June 2, 1897.

JUBILEE ILLUMINATIONS.—Perhaps the most important announcement in connection with the somewhat numerous and wearisome details with which the papers are flooded in connection with the jubilee illuminations is that it has been definitely decided to illuminate the dome of St. Paul's by throwing the light of twenty-five big searchlights upon it. This is not only original, but should prove effective.

THE MARCONI SYSTEM OF WIRELESS TELEGRAPHY.—The House of Commons last week voted £600 toward carrying out experiments in connection with the Marconi system of wireless telegraphy. A few days ago some very successful experiments were carried out on this system in Wales, a Morse "inker" being worked across the Bristol Channel by means of Marconi waves emanating from a distance of nine miles. On Friday next Mr. Preece is expected to give some interesting particulars with regard to the system, about which hitherto there has been considerable mystery.

MR. MORDEY ON DYNAMOS.—The last paper read before the Institution of Electrical Engineers this session was from the pen of Mr. W. M. Mordey. His paper was an extremely interesting and lucid one, and was by far the best contribution to electrical engineering literature that we have had this session, and it is greatly to be regretted that owing to the lateness of its presentation it was impossible to adequately discuss Mr. Mordey's views. The main feature of the paper was a description of a new form of armature winding, applicable to drum as well as to Gramme ring winding. The alteration in the Gramme ring consists merely in dividing each coil into two por-

tions, splaying out each coil to about the distance separating the pole tips. By this means Mr. Mordey hopes to get at the moment of commutation of each coil a reversing E. M. F. sufficiently strong to prevent sparking, and the results of a test upon a comparatively small machine would seem to completely justify his expectations, that by this means he has reached that "Ultima Thule" of dynamo designers, viz., absolutely sparkless collection. Practical dynamo designers, however, including Mr. W. B. Sayers, whose own beautiful and effective device for securing sparkless collection will be within the recollection of the readers of THE ELECTRICAL WORLD, were practically unanimous in asserting that Mr. Mordey's device was unworkable for anything but small machines, in which case, of course, the difficulty of sparkless collection is not very great. The main gist of the arguments of Mr. Mordey's antagonists was that the reversing effectiveness of the advanced portion of the divided coil naturally depended upon the field in which it was placed, and that as it was placed within the leading pole fringe, which is weakened by the cross-reaction of the armature, the advanced portion of the coil became less and less effective as the load increased. Generally speaking, Mr. Mordey laid great stress on the advantages of small air gaps and toothed-armature cores. He also brought forward a laminated brush, the conducting strips of which were separated from each other by insulation, the idea of the brush being to aid in sparkless collection by interposing a great lateral resistance to short-circuit currents, while offering no increased resistance to the currents flowing in and out of the brush. This brush again was somewhat severely criticised by many speakers, who pointed out that it really could not effect the purpose which it was stated to, inasmuch as the successive component copper strips successively bridged the mica strips insulating the commutator segments, and therefore short-circuited the coil in the usual manner. Prof. Silvanus P. Thompson, however, hailed Mr. Mordey's paper as the most important contribution to dynamo design which had been made for the last three or four years.

THE DISCUSSION ON MR. RAWORTH'S INSTITUTION PAPER.—The discussion on Mr. Raworth's paper on "The Generation of Electrical Energy for Tramways" at the Institution of Electrical Engineers served to elicit a considerable amount of useful information with regard to the working of electric tramway power stations in this country and abroad. Mr. Raworth's advocacy of the minimum possible subdivision of generating plant was not regarded very favorably by the majority of the speakers. Mr. P. V. McMahon, the engineer to the City & South London Railway Company, stated that he should hesitate to adopt such a small subdivision as the use of only one running engine and one stand-by engine. The load diagram in a traction station, he said, was not as steady as Mr. Raworth had stated, but varied very considerably, and it would be very inefficient to drive a single engine on such a variable load. The old problem as to the relative merits of cut-off and throttle expansion was again brought up, and Mr. Crompton stated that he believed that there was a sort of wave of feeling in regard to the matter, since at some periods electrical engineers seem to be in favor of throttle governing, whereas at other periods they were all in favor of cut-off governing. At the present time he thought they were all in favor of the latter, but he thought that Mr. Raworth had claimed too much for the automatic cut-off governor. One or two speakers pointed out that a purely throttle-governed engine would not answer the purpose of a tramway station, as it had no reserve of power for the excessive loads. Professor Perry suggested that a combined system of throttle and cut-off governing might be adopted, and was reminded that this had already been done by Messrs. Willans & Robinson, who have employed it for their traction station steam engines, as for instance at the City & South London Railway. One speaker suggested a method of governing which had in view an economy of steam in a cut-off engine when the engine was running at considerably above or below its normal load. The method proposed consisted in automatically varying the speed of the engine in the following manner: As the load rose above the normal, the field excitation was diminished and the engine speeded up so as to maintain the cut-off fairly early, that is to say, within the economical limits of cut-off. On the other hand, when the load fell below the normal, the field excitation would be increased and the speed of the engine dropped so as to prevent the early cut-off. These variations of speed would never come into action when the change of load lasted for a considerable time, and the momentary changes of load due to starting and stopping cars would be looked after by the automatic cut-off gear without any change of speed. The effect of this method of governing would be to maintain the engine within the economical range of cut-off, almost during the whole time of its running. The question of combined traction and lighting stations was raised by Mr. Raworth in his paper and called forth considerable discussion. Mr. Garcke stated that he considered the lighting stations were in general charging too much for power for tramways, and he had actually had to break off negotiations for the development of a large number of electric traction schemes in this country simply because he would not pay as much as 3d. or 4d. per unit for energy. On the other hand, Mr. Wordingham, electrical engineer to the Manchester Corporation, stated that, in Manchester, consumers who take 40 horse-power or more for not less than forty-eight hours per week, are charged only 1½d. per unit, a price out of which a profit was being made.

General News.

NEW INCORPORATIONS.

THE CHICAGO TERMINAL TRANSFER RAILROAD COMPANY has been incorporated.

THE MISSOURI RIVER & LOS ANGELES RAILWAY COMPANY has been incorporated at Dakota City, Neb., with a capital stock of $42,000,000.

THE DARLINGTON ELECTRIC LIGHT & WATER-POWER COMPANY, Darlington, Wis., has been incorporated, with a capital stock of $20,000.

THE PEOPLES ELECTRIC LIGHT & POWER COMPANY has been formed at Bedford, Ohio, with a capital stock of $1000. Those interested are C. E. Sanders, N. B. Whiting and others.

THE SAGUACHE COUNTY TELEPHONE COMPANY has been incorporated at Denver, Col., with a capital stock of $21,000. Those interested are Charles Tarbell, J. Tracey Melvin and C. S. Cornelius.

THE MUSCODA & OAK GROVE TELEPHONE COMPANY, Madison, Wis., has been incorporated with a capital stock of $1000. The incorporators are P. B. McIntyre, H. J. Noyes, J. A. Black, and others.

THE CHATFIELD ELECTRIC LIGHT & POWER COMPANY, Chatfield, Minn., has been incorporated with a capital stock of $50,000. The directors are Joseph Underleak, O. L. Ober and M. H. Crane.

THE BRADFORD ELECTRIC COMPANY has been organized at Bradford, Vt., with William Allen, president; H. E. Parker and B. S. Hooker, vice-presidents; George A. Dickey, clerk; and Charles Jones, treasurer.

THE ROSEVILLE TELEPHONE COMPANY has been incorporated at Columbus, Ohio, by James W. McCay, L. S. Kildon, G. T. Young, J. F. Weaver and J. F. Cole. The capital stock of the company is $5000.

THE WAUKESHA ELECTRIC RAILWAY COMPANY, Waukesha, Wis., has been formed with a capital stock of $1000. Those interested are Stanley I. Henderson, Samuel W. Williams, and Fred W. Henderson.

THE NEW ULM TELEPHONE COMPANY has been incorporated at Minneapolis, Minn., with a capital stock of $10,000. The principal incorporators are Joseph Bobleter, A. H. Wagner, J. L. Schoch and H. L. Savensen.

THE OGDENSBURG POWER & LIGHTING COMPANY, Ogdensburg, N. Y., has been formed, with a capital stock of $50,000. The incorporators are Henry A. Sage, Henry Green, Robert E. Waterman and John M. Kellogg.

THE JACKSON TELEPHONE COMPANY has been organized at Jackson, Mich., with a capital stock of $100,000. The incorporators are D. A. Reynolds, C. H. Higdon, E. F. Lowery and John T. Holmes and George E. Benton.

THE MEADVILLE TRACTION COMPANY, Meadville, Pa., has been organized with a capital stock of $350,000. The incorporators are F. R. Shryock, Charles Fahr, George D. Trowen, H. H. Thompson, John J. Shryock and Cyrus See.

THE ENCLOSED ARC LAMP COMPANY of New York City, N. Y., has been incorporated with a capital stock of $5000. The incorporators are Henry Clews, James B. Clews, William H. Acken, John Acken and William H. Perrine, of New York City.

THE LITTLE WOLF RIVER TELEPHONE COMPANY has been incorporated with a capital stock of $6000. The incorporators are E. H. Jones, H. E. Rupler and A. L. Hutchinson. The headquarters of the company will be at Weyeauwega, Wis.

THE MISSISSIPPI RIVER, HAMBURG & WESTERN RAILWAY COMPANY, Little Rock, Ark., has filed articles of incorporation, with a capital stock of $500,000. The incorporators are James S. Parker, E. K. Devereux and Col. W. P. McConley.

THE SAN GABRIEL ELECTRIC COMPANY, Los Angeles, Cal., has been incorporated for the purpose of acquiring and selling power for application to mechanical and other devices, etc. The directors are M. H. Weed, Carroll Allen, Joseph D. Wiley, John A. Elliott and Sam J. Chase, all of Los Angeles. Capital stock, $25,000.

THE CONTINENTAL ELECTRIC COMPANY has been organized at Portland, Me., for the purpose of manufacturing and dealing in electrical appliances. The officers are President Walter B. Hill, of West Duxbury, and Treasurer John G. Robinson, of Pembroke.

THE MARCELLUS ELECTRIC RAILWAY COMPANY has been incorporated at Albany, N. Y., to operate a street surface road two and one-half miles long from the New York Central station in the town of Camillus to Marcellus, Onondaga County. The incorporators are Townsend K. Cheyney, H. M. Fordham and L. J. Chase, of Buffalo; Edmund Reed, Charles J. Brown, Levi M. Mogg, John M. Seymour and Edward Moir of Marcellus, and John G. Stevens, of Syracuse. Capital stock, $60,000.

THE TELEGRAPH AND TELEPHONE.

CLATONIA, NEB.—A company has been organized in this place to build a telephone line from Clatonia to Cortland.

LOVELAND, COL.—There is some talk of building a telephone line from Estes Park, either to Loveland or Longmont.

CLEVELAND, TENN.—The question of building a telephone line from Cleveland to Tucker Springs is being agitated.

ST. JOSEPH, MO.—The Citizens Telephone Company of this place has completed connections with various towns in this vicinity.

DECATUR, ILL.—The Interstate Telephone Company has put up a line, which connects with the Citizens Mutual Company's line at Tuscola.

NELSONVILLE, OHIO.—Mr. L. B. Engle, of Nelsonville, Athens County, Ohio, has been granted a franchise to establish a telephone exchange in that place.

LOUISVILLE, KY.—The East Tennessee Telephone Company is building a new line from Frankfort through Lawrenceburg, Salvisa, McAfee, Harrodsburg, Danville and Stanford.

JOHNSTOWN, PA.—The West Millville Telephone Company has completed its line from New Bethlehem to Smicksburg, where connections have been made with the Indiana and Armstrong County systems.

CHARLOTTE, N. C.—The Railway Commission has issued an order reducing telephone rates in this State to a maximum of $34 per year for business houses and $24 for residences. The present maximum charges of the Bell Company are $40 and $24, respectively.

HUMESTON, IA.—The Garden Grove & Humeston telephone line is being extended to Derby, and from there it will be carried to Chariton. This will give Humeston telephone connection with all the surrounding towns.

MARION, OHIO.—The construction of another telephone line in this section of the country, including all the cities and towns within a radius of 100 miles from this place, is one of the probabilities of the future.

MONTPELIER, VT.—The Vermont Telephone & Telegraph Company has completed its line to the top of Mt. Mansfield, where a long-distance instrument has been installed. This is the highest point in Vermont.

SLATER, MO.—An effort is being made to procure a sufficient number of subscribers for telephones to justify the organization of a company to furnish good telephone service in this place. Mr. D. V. Harider is interested.

TIFFIN, OHIO.—The Home Telephone Company, composed principally of local business men, has been granted a franchise for twenty-five years, provided the plant is completed in one year. Work will commence at once, and the rates will be $24 for business houses and $18 for dwellings.

MOBILE, ALA.—The Interstate Telephone Company has been organized to operate a telephone line between Whistler, Ala., and Waynesboro, Miss. This line will be connected with others already in operation and will be an important addition to the business facilities of Mobile, as it will be connected with the Home Company's line, now in operation here.

ELECTRIC LIGHT AND POWER.

CHESTER, S. C.—It has been decided to issue $50,000 in bonds for a water and light plant.

DUNKIRK, OHIO.—The citizens are taking steps toward the establishing of municipal lighting.

MINOT, N. D.—A franchise for an electric light and telephone system has been granted to Allen Tompkins.

EAGLE RIVER, WIS.—Eagle River is to have an electric light system for lighting its streets and business places.

WORTHINGTON, IND.—Messrs. Dearmin & Morris have purchased ground on which to locate an electric light plant.

GRACEVILLE, MINN.—The proposition to put in an electric light plant at this place was carried at a recent special election.

HANCOCK, MICH.—At a special election a few days ago, the proposition to instal a municipal electric light plant was defeated.

KINGSTON, N. C.—The town of Mt. Airy has sold $25,000 bonds for water works and electric light plant, and will immediately put in both.

DES MOINES, IA.—On May 17 the voters of this city by an overwhelming majority declared in favor of a municipal electrc lighting plant.

HOUSTON, TEX.—The Council has under consideration a recommendation to issue $100,000 in bonds to establish a municipal lighting plant.

SCRANTON, PA.—The Freeland Electric Company has increased its capital stock from $15,000 to $30,000, and will at once make extensive improvements.

TAUNTON, MASS.—An order authorizing the appropriation of $125,000 for the purchase of the electric-lighting plant, has been adopted by the Common Council.

MAQUOKETA, IA.—The Barnes Electric Company has purchased a water-power site four miles east of this place, and will at once begin work to develop the same.

HARTFORD, CONN.—The Mayor was ordered to make a contract for four years with the Central Railway & Electric Company for street lights at $90 a light of 1200 candle-power a year.

WOLFBORO, N. H.—An electric light plant is to be established in this place, in accordance with the recent popular vote, and bonds for the construction of the same will be issued.

STURGIS, S. D.—The Government has entered a contract with the electric light company in this city to introduce electric lights at Fort Meade. This will effect a saving of $300 a year over kerosene oil.

RENNSALAER, IND.—The municipal ownership of the electric light system is a subject of considerable agitation here. The present company is trying to secure a contract for the city lighting for ten years.

DUNKIRK, OHIO.—A petition is being circulated and signed by the most prominent citizens and taxpayers for the purpose of bonding the town to secure funds to establish an electric street-lighting system here.

EASTON, PA.—A party of capitalists, including T. A. H. Hay, of this city, has purchased of Gen. W. E. Doster a large woolen mill at Bethlehem, which is to be converted into a plant for the manufacture of electrical supplies.

JACKSONVILLE, TEX.—The City Council granted J. R. Roberts the exclusive privilege of operating an electric-light plant in Jacksonville for ten years. The plant will be put in right away, if the required number of lights are contracted for.

NEW BRITAIN, CONN.—The Common Council will make a contract with the Central Railway & Electric Company for street lights at $90 per year per lamp of 1200-cp, to run all night, for 317 nights of the year. The contract is to run for four years.

ELDORA, IA.—Mr. W. S. Porter has purchased the plant of the Eldora Electric Light Company, paying therefor $25,000. It is stated that Mr. Porter will run a heating plant in connection with the electric lighting. The electric light plant is regarded as one of the best in the State.

MERIDEN, CONN.—The Meriden Electric Light Company is making some extensive improvements in its plant for the purpose of establishing a power circuit in Meriden. The new system will supply light and power at a distance of about one mile from the plant. The company has other improvements in view.

NEW YORK CITY, N. Y.—Mr. R. Santos, of the firm of R. Santos & Co., of this city, has recently purchased the electric light plant of the Companhia de Luz Electrica Paraense, in Para, Brazil. The price paid for the plant is said to be $90,000.

BEDFORD, OHIO.—The Bedford Electric Lighting Company's plan was sold at auction a few days ago by Receiver C. A. Ennis. The plant, including apparatus and building, was sold for $6330. It is stated that the Akron, Bedford & Cleveland Railway Company purchased the property.

ALBANY, N. Y.—The Niagara Falls Power Company has filed a certificate of an increase of its capital stock from $3,000,000 to $3,500,000. The company's debts do not exceed $10,000, outside of the mortgage indebtedness incurred to secure the purchase price of real estate and the payment of certain bonds.

LANSING, MICH.—The Michigan Senate has agreed to an appropriation of $20,000 for an electric light plant for the State University, and the House Ways and Means Committee has reported favorably on an appropriation of $25,000 for a lighting plant for the State Capitol, and probably other State institutions in the city.

BALLSTON SPA, N. Y.—The Ballston Electric Light & Power Company and the Ballston Spa Gas Works were consolidated on June 1, under the title of the Ballston Spa Light & Power Company. The capital stock of the new company is $35,000, and the officers are: H. J. Donaldson, president; S. C. Medbery, vice-president and treasurer; H. C. Westcot, secretary; directors, H. J. Donaldson, John S. Butcher, Neil Gilmour, H. C. Westcot and S. C. Medbery. The company proposes to enlarge and improve its electric light plant.

FARIBAULT, MINN.—The city has entered into a five-year contract with the Star Electric Company for street lighting, commencing July 28 next. The city will use forty-three 2000-cp arc lights and 103 32-cp incandescent lamps. The arcs will burn from dark until midnight at a cost of $4.25 per month each, and fifty-nine incandescents will burn during the same hours at an expense of 85 cents per month each. The city is privileged at any time during the life of the contract to purchase the plant at a price to be determined by three arbitrators.

THE ELECTRIC RAILWAY.

BALTIMORE, MD.—Ground has been broken for the new extension of the Pikesville, Reistertown & Emory Grove Electric Railroad Company.

FARMINGTON, ME.—It was voted by a substantial majority to donate the sum of $2500 to the Franklin, Somerset & Kennebec Railroad Company.

BALTIMORE, MD.—Mayor Hooper has signed the ordinance giving the right to lay tracks on Canton Avenue from Collington Avenue to Chester Street.

CLEVELAND, OHIO.—The County Commissioners have granted a franchise to the Cleveland, Painesville & Eastern Railway Company for twenty-five years. The road is to be completed by December 31, 1897.

BURLINGTON, VT.—The project of building an electric road from St. Albans to the bay, for which a charter was obtained, is being agitated, and there is some talk of continuing the road to Maquam and Swanton.

BROOKLYN, N. Y.—The Nassau Electric Railway Company has opened its new terminal at Coney Island, which improvement, it is stated, will greatly facilitate the handling of the large crowds and the dispatch of the cars.

BELLEFONTAINE, OHIO.—H. C. Scheide, of the Buckeye Pipe Line Company, of Lima, will meet Bellefontaine capitalists at Lake Ridge resort to talk over the proposed electric line from Lima to Bellefontaine by the way of Lake Ridge.

LANCASTER, PA.—The United States Circuit Court has authorized Receiver Given to extend the Lancaster & Lititz road from its present terminus through the borough to Center Square as soon as satisfactory ordinance is passed by the Council of Lititz.

SALEM, ORE.—The Salem Light & Traction Company has purchased the property of the Salem Motor Railway Company. The company's railway system includes 11 miles of track, fourteen motor cars and four trailers. General Electric motors are used on the cars.

MARLBORO, MASS.—An electric railway from a point east of the village of Ashland, thence to Fayville to connect at the latter place with the proposed Framingham, Southboro and Marlboro line, is projected by gentlemen interested in the South Middlesex electric railway.

KALAMAZOO, MICH.—It is stated that owing to the scarcity of money the proposed Battle Creek, Kalamazoo & Gull Lake electric road will not be built this season. Parties interested in the scheme, however, are planning to unite several other Michigan cities by trolley lines, including Jackson, Battle Creek, Lansing and Kalamazoo.

KINEO, ME.—It is stated that an electric road will be built along the Moosehead and Chamberlain lakes, touching at all the principal summer resorts. New York capital, it is stated, is interested in this project. Mr. O. A. Dennen, proprietor of the Kineo House at Moosehead Lake, is one of the most interested parties resident in this vicinity.

NEWARK, N. J.—According to the statement of the State Board of Assessors, just issued, the total receipts of street railways in the State during the past year increased $713,573 over those of the previous year, and the expenditures increased $114,236. The highest cost of construction per mile was that of the Consolidated Traction Company, namely, $202,700. The company has a capitalization altogether of $19,788,000.

NEW YORK CITY, N. Y.—A motion to continue the temporary injunction obtained by the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway Company, restraining the Metropolitan Street Railway Company from interfering with the plaintiff company's tracks at Fifty-ninth Street and the Boulevard, in order to substitute electricity for horse-power on the belt line, has been denied by Justice Andrews in the Supreme Court. Justice Andrews holds that the consent of the State Board of Railroad Commissioners to the change of motive power is sufficient to authorize the defendant company in excavating under the belt line tracks.

LEGAL NOTE.

MANUFACTURING UNDER PATENTS.—A decision interesting to manufacturers operating under patents was handed down on June 1 by the United States Circuit Court of Appeals for the Third Circuit, on an appeal from the Circuit Court for the Eastern District of Pennsylvania. The bill in the case was filed in the Circuit Court of the United States for the Eastern District of Pennsylvania, by the Ewart Manufacturing Company, against James H. Mitchell, to enjoin the alleged infringement of the claim of letters patent No. 264,139, issued September 12, 1882, to James M. Dodge for an improvement in chain cables—generally known as the "Dodge chain." That court was of the opinion that Mitchell's device did so infringe, and decreed an injunction. The respondent appealed from this decree, and the case went before the Court of Appeals for review. The important feature of the decision is its emphatic assertion of the principle that the inventor and patentee of a really new and valuable improvement is entitled to the protection of the law under a broad view of the scope of the invention, and cannot be juggled out of his rights by the substitution of differing details in a substantially equivalent device. The decree of the lower court was affirmed.

PERSONAL NOTE.

MR. A. L. REINMANN, for several years general superintendent of the Sawyer-Man lamp factory, is now general superintendent of De Laval's Svea lamp factories (Glodlampfabrik), Stockholm, Sweden. This is one of the largest factories in Europe, having a capacity of 10,000 lamps a day. The company operates its own gas works and glass-house. In the plant Berrenberg metallic pumps are used in part.

Trade and Industrial Notes.

BOILER FEED PUMPS.—The Goulds Manufacturing Company, Seneca Falls, N. Y., has issued a pamphlet on its well-known boiler feed and power pumps. Various designs of these machines are illustrated and tables of capacities and sizes are given. Considerable information about power pumps is also included in the pamphlet.

LARGE STOCK OF PORCELAIN GOODS.—The Electric Appliance Company, Chicago, has recently increased its stock of porcelain goods to the point where it claims it now carries the largest and best assortment of porcelain insulators, tubes and cleats in the West. Its stock includes several hundred different styles of porcelain insulators, brackets and cleats.

BUSINESS CHANGES.—Messrs. H. D. Bayne & Co. announce that they have secured the services of Mr. A. H. Dudley, late of the Dudley Engineering Company. The firm has decided, for greater convenience, to consolidate its offices and storerooms, and has discontinued its former offices at 39 Cortlandt Street. Its headquarters are now at 234 Greenwich Street, New York.

X-RAY SPECIALTIES.—A little pamphlet has just been issued by Mr. James G. Biddle, Philadelphia, on the various X-ray specialties handled by that gentleman. Descriptions are given of the Bowdoin X-ray focus tube, the "W. S." universal X-ray tube stand, and barium platino-cyanide fluoroscopes. Many well-known physicians and institutions are using the "W. S." X-ray apparatus and a list of some of these indicates that these X-ray outfits are growing in favor.

STEAM SPECIALTIES.—A complete and well-illustrated catalogue has just been issued by Jenkins Brothers, New York, and among the new specialties illustrated is the Excelsior back-pressure valve, which is claimed to be the only valve on the market that can be entirely removed from the passage of the exhaust without having to take the valve apart. The catalogue includes descriptions and illustrations of valves of all kinds, Jenkins' packing, etc., etc.

A BUSY FACTORY.—Notwithstanding the Supreme Court decision, the Missouri Telephone Manufacturing Company, St. Louis, Mo., seems to keep its factory very busy filling orders, and it has a number of new contracts on hand. It will soon be compelled to increase its floor space or move into more commodious quarters, as it has hardly enough room to meet all the demands on its facilities, although it now has one of the largest establishments of the kind in the country.

DIAGONAL PACKING.—Mr. Charles A. Daniel, Philadelphia, Pa., in a circular just issued, announces the granting of a preliminary injunction against Norman B. Miller, et al., in Mr. Daniel's suit against them for infringement of his patent for the packing known in the market as the "Diagonal" and the "P. P. P." He cautions makers of and dealers in packing against infringement of his trade-mark rights by the use, in connection with packing not of his manufacture, of the trade-marks quoted above.

ENLARGING ITS QUARTERS.—Owing to the rapid enlargement of the business in the supply department, the Western Electric Company, Chicago, has just completed a new addition to its salesrooms, which doubles its previously large capacity. In connection with the addition a large and handsomely-equipped storeroom is provided, in which will be placed for display a large assortment of ornamental arc lamps, chandeliers, globes and electrical devices of all kinds in actual operation, thus giving customers an opportunity to see a great variety of goods in actual operation. The entire office is handsomely decorated and seems to be wholly adapted to the large increase in requirements.

THE JANDUS ELECTRIC COMPANY, Cleveland, Ohio, announces that it will hereafter sell directly to agents, dealers and consumers the Jandus arc lamps heretofore known as the "Manhattan," and sold through the Manhattan General Construction Company, New York. President Potter, of the Buckeye Electric Company, is also president of the Jandus Electric Company, and the stockholders of both corporations are practically the same. Mr. Potter says that the Jandus Electric Company had good and sufficient reasons for withdrawing the selling agency of the lamp from the Manhattan General Construction Company, and that the only difference to the purchasers of the lamp will be that hereafter they will obtain them from the Jandus Electric Company instead of from the Manhattan General Construction Company. THE ELECTRICAL WORLD has received from the latter company a letter saying that the action of the Jandus Electric Company in terminating the agency contract is unwarranted and illegal, and that the Manhattan General Construction Company has instituted proceedings in the courts to compel the Jandus Company to continue to supply it with lamps as heretofore. In this letter the Manhattan Company adds that it is advised by its counsel that within a very few days the courts will decide that the Jandus Company will be compelled to comply with the terms of its agreement with the Manhattan General Construction Company.

A NON-POLARIZING DRY BATTERY.—The O. K. dry battery, manufactured by the Non-Polarizing Dry Battery Company, 347 West Broadway, New York, is said to be constructed on lines radically different from those of all other dry cells. It is claimed to have proven itself to be a successful competitor with all existing forms of sal-ammoniac cells. Polarization is reduced to a minimum; the output is steady and continuous; it is free from local action; it is compact; it generates a large current, and it is unaffected by heat or cold—these are some of the claims made for this cell. The leading railroad companies and gas-engine manufacturers are using them, as are also telephone companies, manufacturers of electro-medical apparatus, etc.

THE BATTERY-FAN MOTOR business of the Knapp Electric & Novelty Company, New York City, is assuming large proportions, notwithstanding the backwardness of the season. The new "Little Hustler" is well named. With a 5-inch fan, this machine, operated by one cell of ordinary carbon-cylinder battery, creates a breeze satisfactory to many for use on the desk or in the bedroom. The battery is such as is used in the ringing of bells, using an acid solution instead of sal ammoniac. This motor is meeting with much favor, on account of its workmanship and ease of management. It is made in three sizes, driving 6, 8 and 10-inch fans, respectively. After seven years' experience and push, this company stands among the leaders in its particular line. Its business this year is larger than it was last, and its products have been much improved.

ARMATURE PRESSES AND DIES.—The Ferracute Machine Company, Bridgeton, N. J., manufacturer of presses and dies, reports business very brisk. It is running a full force of about 150 hands, and working overtime. It has recently received a number of large foreign orders, from England, France, Germany, China, etc. Among these is one for a large double-crank press for cutting out armature discs, which will be shipped to Budapest. It has already sent some of its presses to the firm from whom this order was received. The company makes a specialty of presses and dies for electrical work, as well as for bicycles, coining presses and general sheet-metal work. It has special facilities for making large dies for armature discs, and is always glad to give estimates on receipt of drawings or samples. It issues a catalogue describing about 300 different sizes and kinds of presses.

POWER-TRANSMITTING MACHINERY.—At No. 141 Liberty Street, New York, may be seen a complete line of the latest and most improved machinery for the transmission of power, manufactured by the George V. Cresson Company, Philadelphia, Pa. This company has recently removed its New York office to the above address, where it has commodious quarters for the proper display of its products. It has been in the business forty years, and is prepared to furnish complete drawings and specifications for and to equip power plants of any size. It has one of the largest and best equipped works in the country for the production of power-transmitting machinery and accessories. The list includes patent turned-steel shafting, internal-clamp couplings, self-oiling bearings, clutch pulleys, etc. The company also makes machine-moulded and cut-gearing of any size, for which work it has special and ample facilities.

GRAVITY CONDENSATION RETURN SYSTEM.—The Holly Steam Engineering Company, Hartford, Conn., continues to do an increasing business with the Holly gravity return system, and the outlook is even better than ever. One of its recent and most notable installations is that of the new power house at Berlin, Conn., N. Y., N. H. & H. R. R. Company. This system has also been recently adopted by the West Chicago and Lake Street Elevated roads, Chicago, and it is also specified for the Union R. R.., Northwestern R. R. and Alley Elevated R. R. systems, Chicago. These recent orders form a praiseworthy addition to the already conspicuous list of lighting and railway plants who are using this excellent system for returning condensation, and as the company is now in most capable hands, Mr. R. N. Platt, of Hartford, a prominent citizen and manufacturer of that city, being its president, the business will undoubtedly show constant advancement.

TAPS AND DIES.—The J. M. Carpenter Tap & Die Company, Pawtucket, R. I., was founded by Mr. J. M. Carpenter in 1870, and incorporated in 1891, and is claimed to be the oldest house in the country manufacturing a general line of screw-cutting tools. It is still under the personal management of its founder, who has made almost a life study of the requirements of tools for cutting screw threads and their accessories, and he has been constantly on the alert to make improvements whereby he might better the quality and accuracy of his goods. A large portion of the machines used in this establishment were designed by Mr. Carpenter and built in the company's own works. These machines are largely automatic in their operation, thus avoiding in a large measure inaccuracies due to inattention of the attendant, besides increasing the output. The company makes more than 4000 different sizes and kinds of regular sizes of screw-cutting tools and constantly employs a part of its works in making to order special sizes and kinds. The great development of the electrical industry has largely increased the demand for screws, so also has the bicycle industry, which calls for sizes and threads previously unheard of, necessitating on the part of manufacturers of screw-cutting tools almost endless work in keeping up the great variety of tools and gauges required in their manufacture. This company also makes a variety of stocks and screw plates for properly holding dies, tap wrenches, half-dies for blacksmiths' use, die holders for using dies in lathes, etc. It devotes all its energy

and entire works to the making of screw-cutting tools. It has a three-story iron and brick fireproof vault, heated by steam, to prevent rust, in which are kept all its finished goods, as well as expensive gauges, standards, etc. Its customers are in every State in the Union, while its shipments abroad are constantly increasing. The company employs nearly 100 hands in its factory, which is running at its full capacity.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

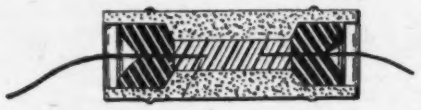
Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 1, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

583,452. ELECTRIC SWITCH; T. H. Brady, New Britain, Conn. App. filed Feb. 1, 1897. A pair of circuit terminals and a lever-handle, which is provided with a terminal disc, and is pivoted thereby between the parallel cheeks of one of said terminals, said disc being of uniform thickness equal to the distance between those cheeks, in combination with a circuit-closing blade, which is of the same uniform thickness between those cheeks, and is adapted to turn on said disc as a pivot.

583,524. UNDERGROUND-RAILWAY CONDUIT; A. G. Wheeler, New York, N. Y. App. filed March 5, 1896. A slotted conduit comprising slot rails, supports to which the same are bolted, and guide rails to which are



No. 583,589.—Electric Connector.

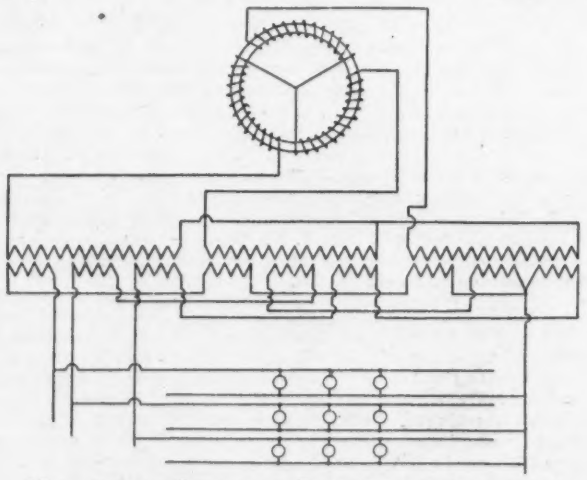
secured to the slot-rail supports by being inserted between said slot rails and their supports.

583,525. ELECTRIC RAILWAY; A. G. Wheeler, New York, N. Y. App. filed March 5, 1896. The combination, with a supporting bar and traveling-contact devices carried by the same, of a guide-flange located on the bar above the traveling-contact devices and projecting laterally therefrom to engage the opposite sides of the slotted conduit, said flange being provided with a sleeve, which surrounds the bar, and serves as a means of supporting the flange thereon.

583,575. COLLECTOR FOR ELECTRIC RAILWAYS; L. J. Hirt, Brookline, Mass. App. filed Sept. 6, 1895. In an electric collector for railroads, in combination, a frame suspended from the car, a series of contact plates on each side of the frame and insulated therefrom conducting strips, whereby the current is conveyed from the contact plates through the collector, and an insulator between the series of contact plates on each side of the frame.

583,589. ELECTRIC CONNECTOR; F. E. Austin, Hanover, N. H. App. filed Jan. 7, 1897. In an electric connector, the combination, with an insulating casing, of elastic-closing plugs for the same, provided with pin-hole apertures for the insertion of the ends of the conducting wires, and a conducting amalgam in said casing adapted to establish an electrical connection between the inserted ends of the wires.

583,622. SYSTEM OF ELECTRICAL DISTRIBUTION; P. M. Heldt, Chi-



No. 583,622.—System of Electrical Distribution.

cago, Ill. App. filed Nov. 16, 1896. In a system of electrical distribution, the combination of a source of polyphase current with a plurality of primary coils in circuit therewith, and a plurality of secondary coils in secondary circuits, said secondary coils being disposed in substantially equal inductive relation to each of said primary coils.

583,630. ELECTRIC GAS-LIGHTER; J. Y. Parke, Philadelphia, Pa. App. filed Jan. 2, 1897. In an electric gas-lighter, the combination of a burner having a gas-cock, a fixed electrode near the burner tip, a pendant lever operatively connected to the gas-cock, an electrode carried by said pendant lever and a curved spring having two arms normally tending to separate, the ends of said arms being secured respectively to the burner and to the lever, and tending to hold such lever in either of the two positions to which it may be moved.

583,644. ELECTRIC BURGLAR AND FIRE ALARM; J. R. Fraser, Jr., Chicago, Ill. App. filed Feb. 20, 1897. In an electric burglar alarm, the combination of an alarm sounder in a normally-closed circuit, including the windows or doors to be protected, and containing a high-resistance section, a normally-open branch circuit, including said sounder, and containing a low-resistance section, and means for closing said branch circuit by opening said high-resistance circuit.

583,672. CONDUIT; A. L. Daniels, North East, Pa. App. filed Feb. 10, 1896. A conduit consisting of an inner clay tube composed of short lengths or sections, an outer wrapping of wire or tape, and a coat or layer of waterproof material between said tape or wire and the clay tube.

583,692. INSULATOR; E. Renault, Waldo, Fla. App. filed Jan. 20, 1897. An insulator comprising a pin or support, having clamping members formed integral therewith, an insulating-bulb, formed with the circumferential groove in which the members fit, the said bulb being provided with the interiorly-toothed sleeve through which the wire passes and is held by the teeth, and the set-screws located above and below the bulb for securing the clamping members together.

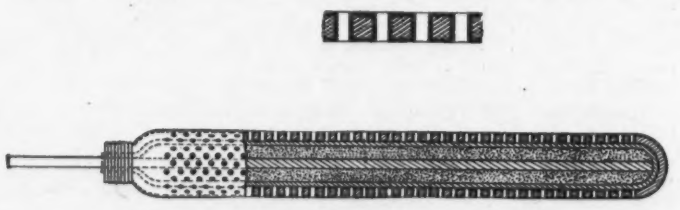
583,787. ELECTRIC INSULATOR; W. Christie, San Francisco, Cal. App. filed Feb. 16, 1897. An electric insulator comprising a metal casing having a bottom closure provided with an opening near one side, an insulating material secured in the upper portion of the casing, a zigzag suspending-rod extending through the opening in the bottom closure and connected to the insulating material in the upper portion of the casing, and an inverted cup-shaped condensing plate arranged within the casing between the lower and central horizontal portions of the suspending-rod.

583,810. SECONDARY BATTERY; J. H. May & F. King, London, England. App. filed Jan. 26, 1897. In or for a secondary battery, an element comprising a conducting plate or support, active material thereon, and a cover or envelope for retaining the active material upon the plate or support, said cover or envelope having an adherent coating of india-rubber to protect it from injurious actions by the electrolyte of the battery or by the gases evolved during the working of the battery.

583,820. FUSIBLE SOCKET FOR ELECTRIC LAMPS; S. H. Russell, Watsonville, Cal. App. filed Dec. 7, 1896. An electric-lamp socket and switch consisting in an insulating-body, a base consisting of an insulating-disc, and a contact plate, connected with said body by standards in electric union with said plate at their lower ends, and with each other at their upper ends; a switch-block and shaft therefor operatively mounted in said standards; an anchoring-stem insulated in and passing through said base and in electrical union with the feed-wire of the lamp, a switch-plate in electrical union with the return-wire of the lamp, the free end of said plate lying in the path of the switch block, and a fusible wire mounted in said body and adapted to break the circuit on excess of current.

583,868. TROLLEY FINDER; G. E. Johnson, Los Angeles, Cal. App. filed Aug. 21, 1896. The combination with a trolley wheel and its support, of a depending frame pivoted upon the axle of the trolley-wheel, two arms pivoted to the said frame and arranged to drop by gravity away from each other in a plane transverse to the trolley-wire, and means for raising said arms to cause them to straddle the trolley-wire.

583,880. ELECTRIC BRAKE; R. M. Hunter, Philadelphia, Pa. App. filed July 14, 1885, divided and re-filed Oct. 1, 1891. In an electrically-propelled vehicle, the combination of the axles of a vehicle, an electric motor mechanically connected with the axle to rotate it, a helix or solenoid surrounding



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one of the axles, means for independently energizing the motor and helix, a frame carried upon the axle and to which the helix and motor are firmly secured, and a movable core surrounding the axle and within the solenoid or helix for creating a friction between the frame of the helix or solenoid and said core when the latter is magnetized.

583,881. SELF-ADJUSTING TROLLEY; C. S. McIntyre, Allegheny, Pa. App. filed Feb. 19, 1895. The combination with a trolley-arm and trolley-wheel carried thereby, of a pair of lateral upwardly-inclined guard fingers each composed of a part rigidly secured to the trolley-arm and a connected yielding portion adapted to be pressed against the side of the arm and terminating below the outer periphery of the trolley-wheel.